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THE CONTRALATERAL FLEXOR REFLEX, REBOUND PHENOMENA, CO-CONTRACTION AND RECIPROCAL INNERVATION IN SPINAL AND IN DECEREBRATE CATS *

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It is generally assumed that the flexor and extensor reflexes are specifically distinct and mutually exclusive. But these reflexes in the legs are not always seen in pure form. Under certain conditions mixed forms occur. Flexor and extensor muscles may contract together either simultaneously or in succession, and it sometimes becomes difficult to draw a sharp line of demarcation between the responses that are primarily flexor and those that are primarily extensor. Furthermore, the rule that ipsolateral stimuli cause flexion and contralateral stimuli cause extension is subject to numerous exceptions. In a previous paper,[1] we mentioned the occurrence of contralateral flexor reflexes, co-contraction and rebound phenomena in the spinal cat. In this paper we shall consider these phenomena in more detail.

The literature on spinal reflexes is so voluminous that an adequate review would far exceed the limits of a single paper. Fortunately, several excellent reviews are available (Sherrington,[2] Forbes[3] and Fulton[4]). There are, however, two papers by Graham Brown[5] that have not received the attention they deserve. They are rich in accurate observations which cannot properly be ignored in the formulation of a general conception of spinal reflex activity. It is perhaps because of this wealth of detailed observations, many of which cannot be fitted readily into a simple formulation, that these papers have suffered this surprising neglect.

Graham Brown studied the contractions in the tibialis anterior and the gastrocnemius muscles in response to stimulation of the ipsolateral

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1. Ranson, S. W., and Hinsey, J. C.: Am. J. Physiol. **94**:471, 1930.

2. Sherrington, C. S.: The Integrative Action of the Nervous System, New Haven, Yale University Press, 1906.

3. Forbes, A.: Physiol. Rev. **2**:361, 1922.

4. Fulton, J. F.: Muscular Contractions and the Reflex Control of Movement, Baltimore, Williams & Wilkins Company, 1926.

5. Brown, T. Graham: Quart. J. Exper. Physiol. **4**:331, 1911; **5**:237, 1912.

and contralateral saphenous nerves with rapid induction shocks. He worked with acute spinal, decapitate and decerebrate cats. He has shown that pure extensor and flexor reflexes do not stand isolated from one another, but that on the contrary there may be a grading in the forms of reaction between the two extremes. "This grading strongly suggests that in each reaction there are factors of flexion and of extension excitation," that a flexion-producing stimulus "does not merely activate the flexor half-center and inhibit the activity of the extensor half-center; but that it causes inhibition of the flexor, and activation of the extensor half-centers as well, although these effects may be neutralized and masked by its chief effects."

In these papers Graham Brown has shown that simultaneous or alternate contraction of two antagonistic muscles may occur in the course of ipsolateral or contralateral stimulation of the nerve, and he has discussed in an illuminating way a variety of rebound contractions. On the basis of this work, he formulated the idea that the spinal reflex center for a limb must be composed of two parts, one exciting the flexors and the other the extensors. These half-centers are thought of as mutually inhibiting each other. He also supposed that some, if not all, of the afferent fibers divide and innervate both half-centers, one stimulus exciting both. Leaving out of consideration all intercalated neurons, such a mechanism might be thought of as arranged in diagram *B*, figure 13. If a stimulus activated both half-centers equally and at the same time, both of the antagonistic muscles would contract. But if one half-center were activated first or more powerfully it would inhibit the other. This conception of mutually antagonistic half-centers has been adopted by Forbes [3] and by Wachholder.[6]

MATERIAL AND METHODS

We have recorded the reflexes at the ankle joint in spinal, decapitate and decerebrate cats. The tibialis anterior and the gastrocnemius muscles were attached to muscle levers weighted with rubber bands. The stimuli were rapid induction shocks from a Harvard coil with 50 interruptions per second and 2 amperes in the primary circuit. With a coil separation of 13 cm. and the secondary coil set at 45 degrees, the stimuli were barely perceptible on the tongue. Stronger stimuli were also used with the secondary coil in varying positions up to a separation of 6 cm. Shielded platinum electrodes were used, and in most instances they were applied to the tibial nerve near the ankle, but sometimes to the saphenous or the femoral nerve. The differences in the results that could be obtained by varying the strength or rate of the induction shocks or the nerve stimulated have been considered in another investigation (Hinsey, Ranson and Doles [7]) and will be briefly summarized in a subsequent paragraph of this paper.

6. Wachholder, K.: Ztschr. f. allg. Physiol. **20**:161, 1922-1923.

7. Hinsey, J. C.; Ranson, S. W., and Doles, E. A.: Am. J. Physiol. **95**:573, 1931.

FLEXOR REFLEXES

In spinal animals the neural balance is shifted toward the flexor side; flexor reflexes are easily obtained and extensor reactions are depressed. This depression can be partly overcome in decapitate dogs by the administration of ephedrine (Hinsey, Ranson and Zeiss [8]). In the decerebrate cat the threshold of the flexor reflex to the single break shock may be lowered by spinal transection (Sherrington and Sowton,[9] Forbes, Cobb and Cattell [10] and Forbes and Baird [11]). It has been said "that in the low spinal preparation the conditions of the centers are definitely set in favor of flexion and against extension, just as in the decerebrate preparation they seem to be set in favor of extension and against flexion" (Graham Brown [12]).

Ipsolateral Flexion.—This flexion is the easiest response to obtain in the spinal animal and is often seen in pure form; i. e., the flexor contraction is accompanied either by no change in the length of the gastrocnemius muscle or by a relaxation of that muscle. Relaxation practically always occurs when the extensor muscles are in a state of tonic contraction at the time the stimulus is applied. Contraction of the tibialis anterior muscle is often followed by a rebound contraction of the gastrocnemius muscle (fig. 3).

Contralateral Flexion.—This flexion is more easily obtained than contralateral extension in the spinal cat. It can be seen in the intact limb (fig. 1) and can be elicited by strongly pinching the toes of the opposite foot, pressing the two outer toes together over the other two. It is more readily produced by strong than by weak stimuli. Sometimes lightly touching the foot will cause crossed extension in a preparation which yields crossed flexion when the toes are strongly pinched together. Electric stimulation of the tibial nerve at the ankle often yields crossed extension when the stimulus is weak, which changes to crossed flexion when the stimulus is increased. This reversal of response was more often seen when the reflexes were observed in the intact limb than when they were recorded on the kymograph (Hinsey, Ranson and Doles [7]). There appears to be a dilemma of reaction (Graham Brown [13]). This may be resolved sometimes in the direction of flexion and sometimes in the direction of extension, but often fails of resolution, in which case no movement occurs.

Graham Brown [13] stated that the usual reaction to stimulation of a contralateral nerve is extension and that a response in which the flexor

8. Hinsey, J. C.: Ranson, S. W., and Zeiss, F. R.: Work in progress.
9. Sherrington, C. S., and Sowton, S. C. M.: J. Physiol. **49**:331, 1914-1915.
10. Forbes, A.; Cobb, S., and Cattell, H.: Am. J. Physiol. **65**:30, 1923.
11. Forbes, A., and Baird, P. C.: Am. J. Physiol. **87**:527, 1929.
12. Brown (footnote 5, second reference, p. 247).
13. Brown (footnote 5, first reference).

contraction predominates is rare. This is certainly true for decerebrate preparations, but is not borne out by our experience on spinal cats. The saphenous nerve that he employed gives crossed extensor reflexes somewhat more regularly than the tibial nerve at the ankle. We believe that the prominence the contralateral flexion assumed in our records may have been due in part to use of the anterior tibial nerve and to the considerable though not excessive strength of the stimuli employed and possibly also to the rapid rate at which the induction shocks were applied (Hinsey, Ranson and Doles [7]).

In decerebrate cats, contralateral flexion is rarely observed. Occasionally, in a preparation that has been studied for several hours after anemic decerebration, we have seen the neural balance gradually shift from the extensor to the flexor side, and under these circumstances have succeeded in recording contralateral flexor reflexes.

As Beritoff [14] pointed out, the tonic neck and labyrinthine reflexes have a profound influence on the character of the limb reflexes. He stated that all of the atypical reflex reactions of decerebrate preparations, including the contralateral flexor reflex, are caused through the excitation of the neck and labyrinthine tonic reflexes. In experiments on decerebrate cats we had this influence in mind and endeavored to reduce it to a minimum by keeping the head fixed in a position of nearly maximal vestibular tonus and the neck straight with the body. But, of course, in low spinal animals all question of tonic influences from the neck and labyrinth is eliminated.

The influence of the tonic labyrinthine reflexes on the reactivity of the spinal centers is well illustrated by the experiments of Girndt.[15] Faradization of an afferent nerve in the hind limb of a supine thalamic cat evokes a brief ipsolateral flexion with contralateral extension, but when the preparation is prone similar stimulation evokes flexion of both hind limbs. This experiment shows the importance of the neural balance between the antagonistic spinal half-centers. In the decerebrate cat and in a supine thalamic cat, tonic impulses from the hind brain reach the spinal cord and tip the balance toward the extensor side. In the absence of these tonic impulses, i. e., in prone thalamic cats and in chronic spinal cats, the flexor half-centers are dominant and a stimulus may cause both ipsolateral and contralateral flexion. We have become so used to the results obtained on decerebrate animals in which the balance is shifted far over to the extensor side that there is a tendency to regard contralateral flexion as unusual or abnormal.

The tibialis anterior muscle seldom, if ever, shortens as much in the contralateral as in the ipsolateral flexor reflex, but otherwise the two reflexes do not differ greatly in character. In both, the contraction

14. Beritoff, J. S.: Quart. J. Exper. Physiol. **9**:199, 1916.
15. Girndt, O.: Arch. f. d. ges. Physiol. **213**:427, 1926.

and the relaxation are abrupt (figs. 2 and 3). Contralateral flexion sometimes rises less abruptly and is often less well sustained throughout the stimulus than is the ipsolateral reflex. It may be accompanied by a relaxation of the extensor muscles (fig. 2), but it is more likely to be accompanied or followed by extensor contraction than is ipsolateral flexion.

EXTENSOR REFLEXES

Ipsolateral Extensor Reflex.—This reflex occasionally occurs in decerebrate cats. We could sometimes produce it by light mechanical stimulation of the tibial nerve, and once we succeeded in obtaining it by very weak electric stimulation of the same nerve. This type of response has been studied in detail by Sherrington and Sowton.[16] Brown and Sherrington[17] met with ipsolateral extension in decerebrate but never in spinal preparations. Socin and Storm van Leeuwen[18] and Beritoff[14] found that this type of reflex could be most easily produced when the posture of the head was favorable for extensor tonus. These observations show the importance of the balance between the antagonistic spinal half-centers in determining the type of response that will be elicited by a given stimulus. Tonic impulses descending from the vestibular centers may tip this balance so far to the extensor side that an ipsolateral stimulus that would ordinarily produce flexion produces extension.

Contralateral Extensor Reflexes.—These reflexes are easily and regularly obtained in decerebrate preparations, but are difficult to elicit in spinal cats. This holds true even when the transection is as high as the fourth thoracic segment and in cats that have been allowed to live for several weeks after the operation. In these preparations, the balance is tipped so far to the flexor side that a stimulus often produces both ipsolateral and contralateral flexion. In spinal animals, contraction of the contralateral gastrocnemius muscle is usually preceded or accompanied by a contraction of the tibialis anterior muscle. In other words, the crossed extensor reflex in spinal cats is usually complicated by simultaneous or alternate contraction of the flexor muscles.

CO-CONTRACTION

In spinal animals it is common to see two antagonistic muscles responding by contraction at the same time or in quick succession. This may occur after either ipsolateral or contralateral stimulation.

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16. Sherrington, C. S., and Sowton, S. C. M.: Proc. Roy. Soc., London **B83:** 435, 1910-1911.

17. Brown, T. Graham; and Sherrington, C. S.: J. Physiol. **44:**125, 1912.

18. Socin, C., and Storm van Leeuwen, W.: Arch. f. d. ges. Physiol. **159:**274, 1914.

Alternate Contractions.—When an alternate contraction of the antagonistic muscles occurs, it is usually the flexor muscle that responds first, and as this relaxes the extensor contracts. All of this occurs while the stimulus continues and remains unchanged. In the tracing reproduced in figure 4, the contralateral flexion is accompanied by a slight relaxation of the extensor muscle which gives place to contraction as soon as the flexor muscle relaxes.

Alternate contractions of the gastrocnemius may follow the contraction of the anterior tibial muscle in response to either ipsolateral or contralateral stimuli. It is sometimes seen as a complication of the crossed extensor reflex in spinal as well as in decerebrate preparations. In this case it takes the form of a brief and slight contraction of the flexor which occurs within the period of latency of the extensor response.

Simultaneous Contractions.—Simultaneous contractions of antagonistic muscles frequently occur in decerebrate as well as in spinal animals

Fig. 1.—Cinematographic pictures of the crossed flexor reflex in the chronic spinal cat. Pinching the toes of one foot causes flexion of the opposite leg (*B*). Before the stimulus (*A*) and after it had ceased(*C*) the leg was held in full extension.

and after ipsolateral as well as after contralateral stimuli. Instances of this type of reaction are shown in figures 5, 6, 8, 9*a* and 10. It may occur during very weak stimulation. The stimulus responsible for the reactions shown in figure 5 was near the threshold. Such tracings demonstrate that a stimulus applied to a nerve trunk is capable of exciting the flexor and extensor motor neuron simultaneously.

Evidences of simultaneous contraction of antagonistic muscles have been seen by numerous observers. The following incomplete list may be given: Graham Brown,[5] Gregor and Schilder,[19] Lewy,[20] Pfahl,[21]

19. Gregor, A., and Schilder, P.: Ztschr. f. d. ges. Neurol. u. Psychiat. **14:** 359, 1913.

20. Lewy, F. H.: Ztschr. f. d. ges. Neurol. u. Psychiat. **58-59:**310, 1920.

21. Pfahl: Arch. f. d. ges. Physiol. **188:**298, 1921.

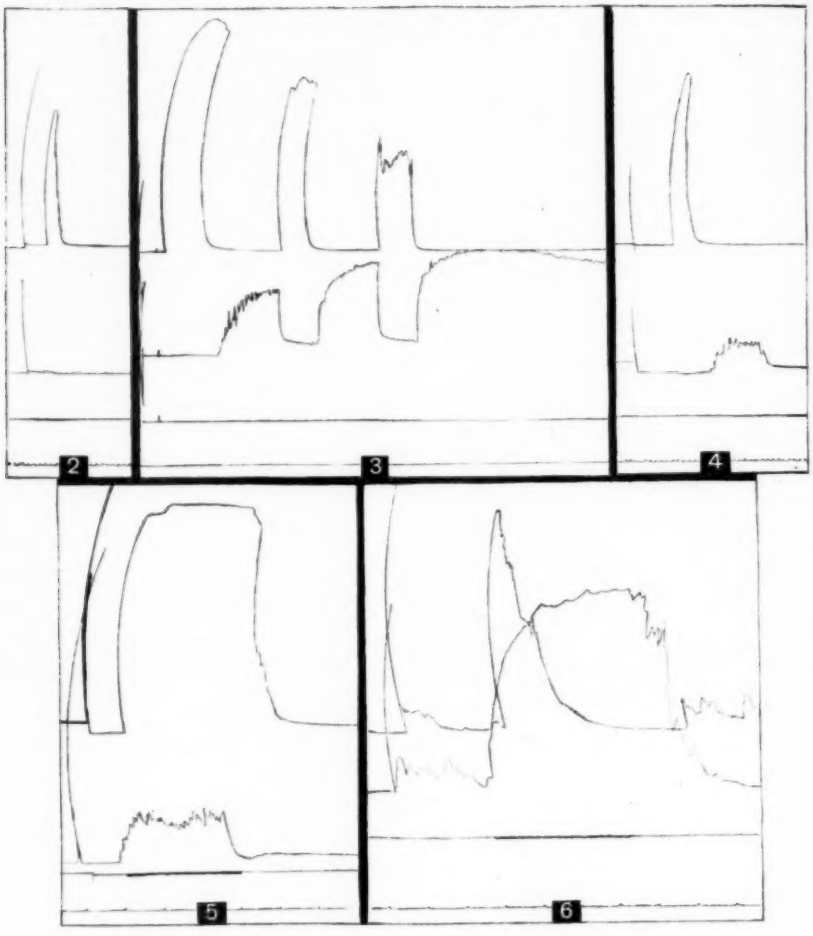
Bethe and Kast,[22] Wachholder,[23] Golla and Hettwer,[24] Tilney and Pike [25] and Pollock and Davis.[26]

REBOUND PHENOMENA

The terminal rebound phenomena that follow the cessation of the stimulus are of importance because of the light they throw on the behavior of the spinal reflex centers. Rebound contraction of the extensor muscle may follow an inhibitory stimulus, which has caused the muscle to relax, or it may follow an excitatory stimulus as an increase in the height of contraction. Such rebounds are frequently encountered in spinal and in anemic decerebrate preparations, especially when moderately strong stimuli are used. They cannot be dismissed as irregular and insignificant phenomena.

Rebound Contraction After Inhibition.—This is a well known phenomenon and has been extensively studied by Sherrington.[2] It is well illustrated in figure *7a*. Here the contralateral flexion reflex is accompanied by marked relaxation of the gastrocnemius muscle, which is preceded by a brief contraction and followed immediately after the cessation of the stimulus by a rebound contraction that carries the lever well above its original position. In figure 12 a series of such rebounds after relaxation is illustrated. It is not, however, necessary that the extensor muscle should relax during the flexor reflex in order for such a rebound to occur. Relaxation cannot occur unless the muscle is previously in a state of contraction. A flexion-producing stimulus applied when both of the antagonistic muscles are at rest is often followed by a rebound contraction of the extensor which is not preceded by any relaxation (fig. 11 and the first response in fig. 3). Sherrington [2] thought that the inhibition might be followed in the extensor neurons by a rebound to superactivity and conceived of the inhibition as causing an accumulation of energy that was released after the cessation of the inhibition. Fulton [4] cited an unpublished paper by Sherrington and Sowton as evidence that the explanation just given may not be the one to which Sherrington would now incline. In fact, Sherrington [27] has said that "many of the afferent nerves possess individually two influences, excitatory and inhibitory, on the same center" and that the excitatory component, though masked during stimulation by the inhibitory component, may outlast the inhibition and perhaps bring about the extensor

22. Bethe, A., and Kast, H.: Arch. f. d. ges. Physiol. **194**:76, 1922.
23. Wachholder, K.: Klin. Wchnschr. **1**:2414, 1922.
24. Golla, F., and Hettwer, J.: Brain **47**:57, 1924.
25. Tilney, F., and Pike, F. H.: Muscular Coordination Experimentally Studied in Its Relation to the Cerebellum, Arch. Neurol. & Psychiat. **13**:289 (March) 1925.
26. Pollock, L. J., and Davis, L. E.: Brain **50**:277, 1927.
27. Sherrington, C. S.: Quart. J. Exper. Physiol. **6**:252, 1913.



Figs 2-6.—Kymographic records of the reflex contractions of the anterior tibial muscle, upper line, and the gastrocnemius muscle, lower line, in chronic spinal cats. Time in seconds.

Fig. 2.—Stimulation of the contralateral femoral nerve; coil separation, 6 cm.

Fig. 3.—Stimulation of the ipsolateral tibial nerve; coil separation, 6 cm.

Fig. 4.—Stimulation of the contralateral femoral nerve; coil separation, 6 cm.

Fig. 5.—Stimulation of the ipsolateral tibial nerve; secondary coil at 13 cm. and set at an angle of 45 degrees.

Fig. 6.—Stimulation of the contralateral tibial nerve; coil separation, 10 cm.

rebound contraction. This is essentially the view proposed by Graham Brown [28] and is the view to which Fulton [4] inclines. It is supported by the fact that contraction of the extensor muscle may follow relaxation of the flexor even though the extensor did not lengthen during the flexor reflex (figs. 3 and 11).

Extensor rebound contraction may follow either the ipsolateral or the contralateral flexor reflex. In our chronic spinal cats the extensor rebound following ipsolateral stimulation was in many cases very prolonged, sometimes lasting more than two minutes. These contractions may have as even a plateau and as gradual a decline as the crossed extensor reflex in a decerebrate preparation.

This tonic activity of the extensor muscle may be built up out of an atonic background, as is well illustrated in figure 3. At the beginning of this record the extensor muscle was at full resting length; there was no tonus, and consequently no relaxation of the extensor muscle accompanying the first flexor reflex. After the cessation of the stimulus a rebound contraction developed, but this contraction did not begin until two or three seconds after the last induction shock. The first rebound built up rather slowly, requiring several seconds to reach its full height. When a second ipsolateral stimulus was applied, this extensor contraction was at once inhibited. In this case of inhibition, as in many other respects, this form of contraction resembles the crossed extensor reflex. Following the second stimulus, an extensor rebound occurred more quickly and reached a greater height, and after the third stimulus the rebound was still quicker and higher. A somewhat similar record is reproduced in figure 12. In the series represented by figure 3, the rebound was allowed to run its course after the termination of the third stimulus, and it persisted for more than a minute and a half, slowly declining toward the base line. It is of great interest that this prolonged contraction was built up in a previously atonic muscle by a series of stimuli which, during their course, were inhibitory.

It is difficult to interpret these results in any other way than on the assumption that the stimulus exerts a double effect on the extensor motor neurons. During the stimulus the inhibitory effect is dominant. It prevents the contraction of the extensor muscle during the course of the stimulus and inhibits any tonic contraction that may exist at the moment. But after the cessation of the stimulus the inhibitory factor wanes more rapidly than the excitatory factor, allowing the latter to produce the rebound contraction. The prolonged extensor after-discharge exhibited in these tracings offers the same problems as the after-discharge in the crossed extensor reflex. In our opinion, such after-discharge can best be explained on the theory of reverberating neuron circuits.[1]

28. Brown (footnote 5, second reference).

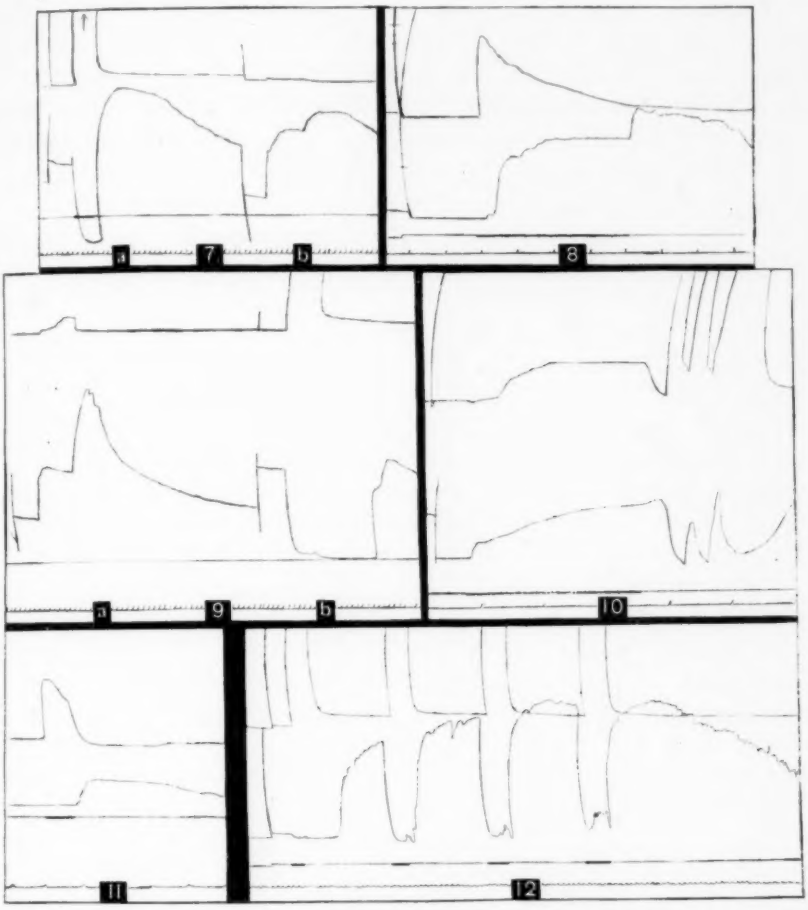
This building up of an extensor tonus as a result of ipsolateral stimulation was a common feature of the tracings that we obtained from chronic spinal cats; however, we have never seen it in decerebrate preparations. Why the extensor neurons should respond with prolonged contractions following the cessation of ipsolateral stimuli so much more readily and show crossed extensor reflexes so much less readily in spinal than in decerebrate preparations, remains undetermined.

Graham Brown [13] found postinhibitory rebound contraction only rarely in low spinal preparations, and these, when they occurred, were of slight extent and apparently of short duration. His were acute preparations, while ours had recovered from the immediate effects of the operation. Sherrington [29] said that in spinal animals extensor rebound contractions occur if enough time is allowed after the transection for the depression due to spinal shock to subside.

Rebound Contractions After Excitation.—These contractions are common phenomena in chronic spinal and in anemic decerebrate cats. They are commonly seen as a result of contralateral stimulation (figs. *7b,* 8 and *9a*). The response to such a stimulus may be a pure crossed extensor reflex with an increase in the height of the contraction immediately after the cessation of the stimulus. But commonly there is some evidence of a simultaneous contraction of the flexor muscle and the rebound coincides more or less in time with the flexor relaxation. This flexor contraction may be barely perceptible as in figure *7b* or well defined as in figures 8 and *9a*. This simultaneous contraction of flexor and extensor muscles shows that both flexor and extensor motor neurons are activated at the same time by the stimulus applied to the nerve. Since neither muscle contracts to its full extent, the activity of each appears to represent a balance between excitation and inhibition. Following the cessation of the stimulus, the flexor excitation rapidly subsides but the extensor excitation persists in the form of an after-discharge and, being freed from the inhibitory factor involved in the stimulus, it brings about an increase in the height of the extensor contraction.

Rebound Relaxation After Inhibition.—This phenomenon is only rarely seen (Graham Brown [28]). One of the few instances that we encountered is represented in figure *9b*. It occurred as part of an ipsolateral flexor reflex to moderately strong stimulation. The gastrocnemius muscle rapidly lengthened during the first part of the stimulus and then retained its new length until after the cessation of the stimulus, when it relaxed somewhat more. This could be explained on the assumption that the response of the gastrocnemius to stimulation represented the algebraic sum of inhibition and excitation and that in this case the excitatory after-discharge subsided first allowing the inhibitory after-

29. Sherrington, C. S.: Proc. Roy. Soc., London **B80**:53, 1907.



Figs. 7-12.—Kymographic records of the reflex contractions of the anterior tibial muscle, upper line, and the gastrocnemius muscle, lower line. Time in seconds.

Fig. 7.—Decerebrate cat. *a*, stimulation of the contralateral femoral nerve; secondary coil at 13 cm. and set at an angle of 45 degrees. *b*, stimulation of the contralateral femoral nerve; secondary coil at 13 cm. and set at an angle of 85 degrees.

Fig. 8.—Spinal cat. Stimulation of the contralateral femoral nerve; coil separation, 6 cm.

Fig. 9.—Decerebrate cat. *a*, stimulation of contralateral tibial nerve; coil separation, 8 cm. *b*, stimulation of the ipsolateral tibial nerve; coil separation, 8 cm.

Fig. 10.—Decerebrate cat. Stimulation of the contralateral tibial nerve; coil separation, 6 cm.

Fig. 11.—Spinal cat. Stimulation of the contralateral tibial nerve; coil separation, 8 cm.

Fig. 12.—Spinal cat. Stimulation of the ipsolateral tibial nerve; coil separation, 8 cm.

discharge to act unimpeded and to cause a further lengthening of the muscle after the end of the stimulus. The rarity of this type of response could be accounted for by the fact that the flexor after-discharge with its inhibitory effect on extensor neurons is as a rule much briefer than the extensor after-discharge.

Rhythmic Rebounds.—The tracing reproduced in figure 10 was obtained from a decerebrate cat as a result of strong stimulation of the contralateral tibial nerve. Simultaneous contraction of both antagonistic muscles occurred during the stimulus, after which stepping movements occurred. This reciprocal contraction and relaxation of antagonistic muscles occurring after a stimulus has been called rhythmic rebound (Graham Brown [13]).

REVERSALS IN REFLEX TYPE

The state of neural balance in the spinal centers is an important factor in determing the type of reflex response obtained. Sometimes in the course of a given experiment this balance will shift so that a stimulus that at first gave a crossed extensor response will later give a response in which flexion predominates, although the strength of the stimulus and the position of the electrode have not been changed. We have seen such reversals with the lapse of time in a number of anemic decerebrate preparations. A change in type of response can often be obtained by changing the strength of the stimulus. In spinal cats, weak stimuli may elicit crossed extension while stronger ones tend to bring in flexion. In some preparations stimulation of the saphenous nerve caused crossed extension while stimulation of the tibial nerve caused crossed flexion. In some decerebrate preparations of the anemic type, rapid faradic stimulation sometimes called the contralateral flexor muscles into activity while slower stimulation of the same strength applied to the same nerve gave pure crossed extension. This reversal with change in rate of stimulation was not seen in decapitate and only once in spinal animals.

Reflex reversals may be obtained by changes in the passive posture of the limb. In general it may be said that if a limb is passively extended its spinal centers become set in favor of flexor reflexes and if it is in a flexed posture the neural balance of the spinal centers favors extensor responses.

The administration of chloroform or ether will sometimes cause a reversal of the effect of a stimulus from excitation to inhibition.

The extensive literature dealing with such reversals has been considered along with our own observations in another paper (Hinsey, Ranson and Doles [7]). The brief summary given here was required because of the importance of such phenomena for a consideration of the mechanism of spinal reflexes.

COMPLEX REACTIONS

Demarcation Between Flexor and Extensor Responses.—This demarcation is not sharp. A pure flexion and a pure extension are completely dissimilar and diametrically opposed reactions. But they are not isolated; they stand at the extreme ends of a more or less graded series of reactions in which evidences of excitation and inhibition may be seen in both of the antagonistic muscles. The contraction phase may occur in the two muscles simultaneously or alternately during the stimulus. Or the contraction of the extensor muscle may occur as a rebound after the cessation of a flexion-producing stimulus. In spinal cats that have been allowed to live for several weeks after the transection, these diphasic reactions can be obtained with ease. This is of importance because it shows that the mechanism responsible for their production is complete within the spinal cord. In making this statement we do not lose sight of the fact that in the intact animal this spinal mechanism is profoundly influenced by and constantly under the control of higher centers.

We agree with Graham Brown that the stimulation of an afferent nerve may cause a compounding of the processes of excitation and inhibition in the flexor and extensor half-centers. Both of the antagonistic muscles may be excited by the one stimulus and both may be inhibited. Quantitative differences between these antagonistic processes in the two antagonistic centers determine the character of the diphasic reaction. It is possible that simple reactions, pure flexion and pure extension, may be due to a compounding of central processes in this manner. That in the records there is contraction alone in one muscle and relaxation in its antagonist is no guarantee that the stimulus may not have excited and inhibited both, although in different degrees. But in stimulating nerve trunks afferent fibers of different functional types are brought into action and it seems probable that if fibers of a single functional type could be stimulated alone, less complex results would be obtained. Probably extensor responses, both ipsolateral and crossed, when elicited by very weak stimuli, come the nearest to being simple reactions uncomplicated by any excitation of the antagonistic half-center.

Strength of the Electric Stimulus.—The strength of the electric stimulus applied to the afferent nerve is a matter of prime importance. The strength of the stimulus required to activate a fiber varies with its diameter (Gasser and Erlanger[30]). The finer sensory fibers require stronger induction shocks to stimulate them than do the large ones. The sensory fibers from the muscles and the tactile fibers are for the most part large, and the pain fibers small (Ranson and Billingsley[31]

30. Gasser, H. S., and Erlanger, J.: Am. J. Physiol. **80**:522, 1927.

31. Ranson, S. W., and Billingsley, P. R.: Am. J. Physiol. **40**:571, 1916.

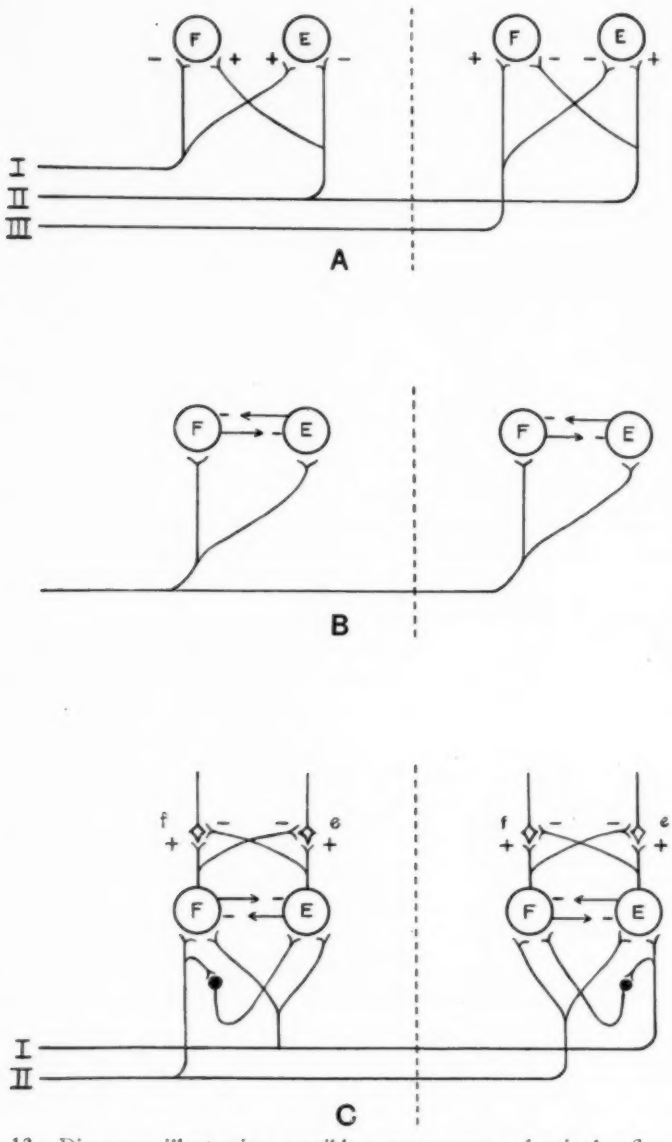


Fig. 13.—Diagrams illustrating possible arrangements of spinal reflex mechanisms.

and Gasser and Erlanger [32]). If threshold stimuli are used, only proprioceptive or tactile fibers are activated; if strong stimuli are employed, all the fibers in the nerve respond. It seems possible to us that many of these reactions that we have been describing—crossed flexion, simultaneous contractions of antagonistic muscles and the rebound contractions—are brought in with strengths of stimuli that activate pain fibers. But sometimes they occur with weak stimuli, as is illustrated in figure 7. The electrodes were on the contralateral femoral nerve. Tracing 7*b* was produced by a stimulus too weak to be felt on the tip of the tongue (Harvard coil with 2 amperes in primary circuit and the secondary coil set at 13 cm., and tipped at an angle of 85 degrees). It produced a crossed extensor reflex followed by a postexcitatory rebound. There was a very slight contraction of the flexor muscle during stimulation. This weak stimulus excited the flexor as well as the extensor centers in the cord. When the strength of the shocks was increased slightly so as to be easily felt but not painful on the tip of the tongue (secondary coil at 13 cm. and tipped at an angle of 45 degrees), there resulted crossed flexion with extensor relaxation followed by extensor rebound (fig. 7*a*). This stimulus was also quite weak, and it may be regarded as doubtful whether it activated the pain fibers.

It may be objected that if only threshold stimuli are used, more simple results can be obtained and that stronger stimuli should under no circumstances be employed. But increasing the strength of the induction shocks only increases the number and variety of the sensory fibers brought into action. Even the strongest induction shock cannot cause anything but a full complement of sensory impulses to reach the cord, and it is important to know how the spinal centers react to such massive volleys of sensory impulses of various types.

RECIPROCAL INNERVATION

Sherrington established the principle of reciprocal innervation of antagonistic muscles, a principle of wide application and of fundamental importance for the understanding of rhythmic movements of progression. He recognized, however, that it did not exclude the possibility of simultaneous contraction of antagonistic muscles. This occurs whenever the joints are immobilized by muscular action. It can be brought about as a voluntary act or reflexly when the limb is rigidly fixed to serve as a prop or support in the Stütz reflex (Schoen [33]). However, it is obvious that for stepping to occur the powerful extensor tonus required for maintaining the standing posture must subside as the

32. Gasser, H. S., and Erlanger, J.: Am. J. Physiol. **88**:581, 1929.

33. Schoen, R.: Arch. f. d. ges. Physiol. **214**:21, 1926.

flexors contract; otherwise the relatively weak flexors would not be able to bend the limbs and raise them from the ground in walking. But it is just as obvious that if when one muscle contracted all its antagonists relaxed at once to their full resting length and remained in the resting state until the agonist had relaxed in turn, the resulting movements would be jerky and uncertain in force and amplitude. One cannot afford to overlook the check action of antagonistic muscles on each other without which finely adjusted movements would be impossible.

The old controversy between simultaneous contraction and reciprocal innervation was based on the misleading conception that they were mutually exclusive. But this is not the case, for simultaneous contraction and reciprocal innervation are both necessary for the proper functioning of the limbs in standing and walking. Both phenomena can be studied in tracings representing the reflex activity of spinal and decerebrate animals. Sherrington [27] pointed out that if the spinal centers are activated at the same time by two antagonistic stimuli the result represents the algebraic sum of their opposite effects. If these antagonistic impulses break in on the twin centers when both are at rest, both muscles may contract, one more than the other. Forbes [3] stated the case fairly when he said, "The flexors and extensors, acting on a single joint, never contract fully together. Any stimulus which succeeds in producing extension will at least partly inhibit flexion."

Reciprocal innervation is most easily demonstrated in decerebrate animals with well marked extensor tonus and especially during the after-discharge from the crossed extensor reflex. Under these conditions the extensor muscles relax when the flexor muscles contract in response to an ipsolateral stimulus. Graham Brown [28] found that in some of his experiments there was normally an extensor contraction complicating the ipsolateral flexor reflex, but if this reflex were elicited following a contralateral stimulus and during the period of resultant extensor tonus the extensor muscle relaxed instead of contracting. That is to say, the same stimulus which caused some slight contraction in the fully relaxed muscle caused it to relax if it was in a state of tonic contraction at the time the stimulus was applied.

Reciprocal inhibition of the extensor muscles may occur in decerebrate preparations as a phase of the crossed flexor reflex (fig. 7*a*) or of the ipsolateral flexor reflex (fig. 9*b*). In chronic spinal cats it can most easily be demonstrated by a series of ipsolateral stimuli spaced several seconds apart so that each successive stimulus is applied while the extensor muscle is in a state of tonic rebound contraction following the flexor reflex initiated by the preceding stimulus (figs. 3 and 12). Under these circumstances a stimulus inhibits a rebound contraction which resulted from an exactly similar preceding stimulus and which recurs again in augmented form after the cessation of the stimulus.

THE NEURAL MECHANISM INVOLVED IN SPINAL REFLEXES

Variability of response is one of the chief characteristics of the central nervous system. Seldom if ever is only one pathway open to an incoming impulse, and it may produce one effect or another according to the state of the centers on which it impinges. The facts presented in the preceding pages show that this holds true for spinal reflexes. These variable responses make it impossible to explain spinal reflex activity on the basis of the simple diagrams that were once in vogue. In regulating the interaction of flexor and extensor reflexes, at least three factors appear to be operative: (1) The fibers in the peripheral nerves are not all functionally alike. Two fibers in the same nerve may have opposite actions on the spinal centers. (2) The flexor and extensor half-centers appear to exert an inhibitory influence on each other. (3) The balance in activity between these two mutually antagonistic half-centers is profoundly influenced by many factors such as the tonic impulses emanating from the labyrinth, the character of which is dependent on the orientation of the head, and proprioceptive impulses the character of which varies with the posture of the limb.

That many sensory nerves contain sensory fibers of opposite reflex sign is now fairly generally admitted. The connection of such fibers with the reflex centers of the two sides of the cord might be represented as in diagram *A* (fig. 13). Since relatively few dorsal root fibers send collateral branches across the spinal cord, the lines must represent for the most part not single fibers but chains of neurons. Line *II* represents an afferent fiber arranged as in the classic diagram of Sherrington. According to the arrangement of the diagram an impulse traveling this fiber would stimulate the flexors and inhibit the extensors of the same leg and excite the extensors and inhibit the flexors of the opposite leg. In decerebrate preparations, ipsolateral flexion and contralateral extension are the responses that usually result from stimulation of the nerve, and such reactions could be understood if the sensory nerve consisted only of fibers of type *II*. But fibers of this type could not account for ipsolateral extension, contralateral flexion, simultaneous contraction of flexors and extensors or postexcitatory rebound.

The fact that an ipsolateral extensor reflex can often be produced in a decerebrate preparation by weak stimulation and that the response is reversed to flexion when stronger stimuli are used makes it probable that there are two types of fibers in the nerve (Sherrington and Sowton [16]). A fiber responsible for ipsolateral extension is represented at *I* in the diagrams on page 260. What seems to be conclusive evidence of the specificity of these fibers has been furnished by McCouch and Alpers.[34] In the same way contralateral flexion could not according to

34. McCouch, G. P., and Alpers, B. J.: Extensor Reflexes from the Knee in Relation to Knee Jerk and to Rebound, Arch. Neurol. & Psychiat. **22**:672 (Oct.) 1929.

this diagram be mediated by the same fibers that are responsible for contralateral extension. Since contralateral flexion can best be produced by strong stimulation, the fibers that are involved cannot be the same as those concerned in iposlateral extension. We are forced, therefore, to draw a third fiber, *III*.

In its original form with only fiber *II* represented, diagram *A* served very well to account for reciprocal innervation of antagonistic muscles. And even when the existence of other afferent fibers, which exert an action on the spinal center antagonistic to that of fiber *II*, is taken into consideration, reciprocal innervation might still be accounted for on the basis of the algebraic summation of the antagonistic effects of these fibers.

It would be possible to explain rhythmic stepping with alternate reciprocal contraction and relaxation of the flexor and extensor muscles on the basis of diagram *A* if it were permissible to include in the essential mechanism the proprioceptive fibers from the participating muscles. Impulses from the active flexor muscle might inhibit the extensor center and vice versa. But it is known that reflex stepping occurs after complete deafferentation of both limbs (Graham Brown,[35] Sherrington [36] and Wachholder [23]). It is clear that proprioceptive fibers do not play an indispensable rôle in the rhythmic alternation of contraction and relaxation occurring reciprocally in the flexor and extensor muscles.

It therefore seems necessary to assume that there is some direct connection by which the activity of one half-center directly inhibits the activity of the antagonistic half-center. This suggestion was first made by Sherrington,[37] but was abandoned in favor of the reciprocal arrangement of the sensory fibers. The conception was taken up again and put in convincing form by Graham Brown.[38] The theory is represented graphically in diagram *B* (fig. 13). According to this scheme, when either half-center is activated from any source it would, by virtue of its direct connections with the antagonistic half-center, inhibit the latter. This provision for mutual inhibition would best account for the fact that whether the excitation comes from the sensory nerves of the same or the opposite side, from the cerebral cortex, from the center for the labyrinthine tonic reflexes or from the red nucleus, the antagonistic muscles obey the law of reciprocal innervation. They never contract to their full extent simultaneously. Graham Brown

35. Brown, T. Graham: Proc. Roy. Soc., London **B84**:308, 1911-1912; J. Physiol. **48**:18, 1914.

36. Sherrington, C. S.: J. Physiol. **47**:196, 1913.

37. Sherrington, C. S.: The Spinal Cord, in Schäfer: Textbook of Physiology, London, Y. J. Pentland, 1900, vol. 2, p. 842.

38. Brown (footnote 28 and footnote 35, second reference).

conceived of the half-centers as consisting of the primary motor neurons and the inhibitory fibers as the collaterals of Golgi given off by the motor axons. It is doubtful if this histologic background adds any support to the theory. Histology reveals nothing concerning the arrangement and connections of the neurons forming these centers and furnishes no foundation on which a diagram could be constructed. In arranging the inhibitory pathways in diagram *C*, we have followed the plan adopted by Wachholder, which is based on purely physiologic considerations.

Since we know that sensory nerves are composed of functionally diverse fibers and since the evidence is strong that two fibers in the same nerve may exert opposite effects on the spinal reflex centers, diagram *B* requires amplification. An arrangement of paths and centers that would explain all the observations presented in this paper is given in diagram *C*. It is assumed that an impulse entering the cord along either fiber *I* or *II* is able to excite both of the antagonistic centers in both legs. An impulse traveling one path may have equally direct access to both members of a pair of half-centers, and it will depend entirely on the neural balance existing at the moment which center becomes active and inhibits its antagonist. Impulses traveling other paths may have quicker access or more points of access to one half-center than to its antagonist. This difference might be brought about in several different ways. In the diagram the less open path has been indicated by the insertion of an additional neuron. Fiber *I* may be thought of as representing a fiber (tactile or proprioceptive?) that can be activated by very weak induction shocks. Its connections with the ipsolateral half-centers are equally direct, and it will produce either flexion or extension according to the neural balance existing between these centers at the moment. On the contralateral side its connection with the extensor half-center has been represented as the more direct because weak stimulation causes crossed extension but seldom if ever crossed flexion. The center to which the impulse has the most direct access, in this case, the extensor center, will be activated first and inhibit its antagonist unless the neural balance is very strongly set in the opposite direction. Fiber *II* may be thought of as representing a fiber (conducting painful impulses?) that can be activated only by relatively strong stimuli. Impulses traveling this fiber have direct access to the homolateral flexor center and seldom if ever produce ipsolateral extension; but they have about equal access to the contralateral twin centers and will produce contralateral flexion or contralateral extension according to the balance existing between these two centers. In a chronic spinal cat with the balance tipped to the flexor side, strong stimuli produce bilateral flexion. In the decerebrate cat with the balance tipped to the extensor side, the same stimulus causes ipsolateral flexion and contralateral extension.

In this discussion we have placed the responsibility for the differences in reflex effect of strong and weak stimuli on the differences in the threshold of stimulation of fibers of functionally different types. But there is another possibility that must be taken into consideration. The change in response with increasing strength of the stimulus might be due purely to an increase in the number of afferent fibers activated.

The diagram would account for the occurrence of simultaneous and alternate contractions of antagonistic muscles, for reflex reversals and for the various rebound phenomena, as well as for reciprocal innervation. For example, rebound contraction after excitation (figs. 8 and 9*a*) would be explained on the basis of the simultaneous activation of both half-centers. During stimulation the flexor center partly inhibits the extensor. It is known that after the cessation of a stimulus the activity of the flexor centers subsides much more rapidly than that of the extensor centers. The inhibition from the flexor half-center on the motor neuron along the path *Fe* ceases and the contraction rebounds to a height corresponding to the extent of the after-discharge in the extensor half-center.

Rebound contraction after inhibition (figs. 3, 7*a* and 11) has essentially the same explanation. The flexor half-center is primarily activated It partly inhibits the extensor half-center along the path *FE* and checks completely the activity of the extensor motor neurons along the path *Fe*. After the cessation of the stimulus the activity of the flexor half-center subsides promptly, allowing the continued activity of the extensor half-center to express itself in the rebound contraction. It will be obvious that the extensor half-center cannot be completely inhibited or there would be no after-discharge to give rise to a rebound contraction. Part of the inhibition must occur downstream from the site of the after-discharge; otherwise no rebound could occur on the release of the inhibition. For the purpose of this discussion it is immaterial what theory concerning central inhibition is adopted. These theories have recently been discussed by Forbes, Davis and Lambert.[39]

SUMMARY

The reflexes at the ankle joint in response to electric stimulation of sensory nerves of the same or the opposite limb were studied in spinal, decapitate and decerebrate cats. The response elicited may be ipsolateral flexion or extension or contralateral flexion or extension, depending on the neural balance between the spinal reflex centers, the nerve stimulated and the strength of the induction shocks. In chronic spinal cats, with the balance tipped to the flexor side, the usual response to moderately strong stimulation is bilateral flexion. In decerebrate

39. Forbes, A.; Davis, H., and Lambert, E.: Am. J. Physiol. **95**:142, 1930.

cats, with the balance tipped toward the extensor side, the usual response is ipsolateral flexion and contralateral extension. Not infrequently the two antagonistic muscles contract simultaneously during the stimulus. Reciprocal innervation can most easily be demonstrated when the extensor muscles are in tonic contraction. Under these conditions any flexion-producing stimulus, whether ipsolateral or contralateral, will cause extensor relaxation. It is maintained that the law of reciprocal innervation cannot properly be interpreted as excluding the possibility of simultaneous contraction. Both simultaneous contraction and reciprocal innervation occur and are essential for the proper functioning of the limbs in standing and walking.

Terminal rebound phenomena—rebound contraction after inhibition, rebound contraction after excitation, rebound relaxation after inhibition and rhythmic rebounds—are described and discussed.

The type of reflex response elicited may sometimes be reversed from flexion to extension, or vice versa, by changing the strength or rate of the stimulus or by shifting the electrode from the tibial to the saphenous nerve, by changing the passive posture of the limb and in some other ways.

The significance of these phenomena—reflex reversals, terminal rebounds, simultaneous contractions, reciprocal relaxations and ipsolateral extensor and contralateral flexor reflexes—for an understanding of the organization of the spinal reflex centers is discussed.

THE ELASTIC LAYER IN THE CEREBRAL VESSELS

STUDIES OF THE NEW-BORN AND OF CHILDREN *

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Few studies of the cerebral vessels of children have been reported. Some of these investigations have been confined to the physiologic development and others to the pathologic changes. In 1917, Binswanger and Schaxel [1] studied the cerebral vessels in a new-born infant and in persons from 30 to 40 and from 50 to 60 years of age. In the new-born, they found that the elastic layer is well developed in all the cerebral vessels except in the small arterioles. According to their opinion, the elastic layer continues to grow up to the age of 40, when retrogression takes place. In 1928, Hackel [2] made a systematic study of the vessels of the circle of Willis in groups of persons from birth to 50 years of age. He observed, as was suggested by Thoma,[3] that the elastic layer of the large vessels is composed of two lamellae, a subendothelial and a bordering one, separated by a lightly stained substance. He also observed that not only is the elastic layer thicker in the small arteries of children of 6 years than in children of 3 months, but that splitting of the elastic layer at the branching of the large vessels varies with age in type and in frequency.

A study of the pathologic changes in the cerebral vessels was first made by Ghetti,[4] in 1910. He observed endarteritis in a boy, aged 10 years, who had died of a hemiplegia. In 1911, Rhea [5] published the report of a case of meningitis due to the influenza bacillus of Pfeiffer in a child aged 5. Hemiplegia developed on the forty-fourth day of the child's illness and persisted with little improvement until death seven weeks later. No areas of softening were found in the brain; there were only internal hydrocephalus and chronic meningitis. Two meningeal vessels showed diffuse intimal thickening, and one a splitting of the elastic layer in a plaque of connective tissue. Talbot [6]

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* From the Pathology Laboratory of the Buffalo General Hospital.

1. Binswanger, O., and Schaxel, J.: Arch. f. Psychiat. **59**:141, 1917.
2. Hackel, W. M.: Virchows Arch. f. path. Anat. **266**:630, 1928.
3. Thoma, R.: Virchows Arch. f. path. Anat. **245**:78, 1923.
4. Ghetti, M.: Brit. M. J. **1**:1, 1910.
5. Rhea, L. J.: Cerebrospinal Meningitis Due to Bacillus Influenzae, Arch. Int. Med. **8**:133 (Aug.) 1911.
6. Talbot, F. B.: Contrib. Med. & Biol. Research **1**:1004, 1919.

also observed foci of intimal thickening of two meningeal vessels in a case of ruptured aneurysm of the middle cerebral artery in a child whose previous illnesses were bronchitis, measles, whooping cough and appendicitis. Ford and Schaeffer [7] reported thrombosis and intimal proliferation of connective tissue and elastic fibers with the deposition of fat in the cerebral vessels of a child aged 3. At 6 months, this child had been ill with measles and at 2 years with scarlet fever. The boy died of a hemiplegia that occurred during an attack of coryza. Autopsy revealed softening of the cortex, the basal ganglia and the internal capsule. Recently, in my study [8] of a case of lead poisoning in a previously healthy child, aged 20 months, a vessel with an intimal thickening of elastic fibers and connective tissue was found in the meninges above the island of Reil. Other vessels with intimal thickening were not found, but proofs of vascular changes were apparent in the sclerosis of the Sommer sector of Ammon's horn and in the glial arborization of the molecular layer of the cerebellum. Although it seemed probable that intoxication due to lead had been the cause of the lesions, it also seemed possible that a study of the cerebral vessels in other children might show a relation of the physiologic development of the elastic layer to its apparent pathologic changes.

METHODS

The cerebral vessels were examined in two stillborn fetuses and in twenty-four children, varying in age from birth to 14 years. The usual sections were taken from the brain, fixed in alcohol and embedded in celloidin or in paraffin. The paraffin blocks were discarded as they showed so much dehydration that a study of the vessels was difficult. The large cerebral vessels were fixed in formaldehyde and embedded in paraffin. The stains used were the usual ones for blood vessels and included Herxheimer's stain for fat or frozen sections.

RESULTS

Since the cerebral vessels are of the muscular type, they have a thin media and adventitia with one elastic layer, the internal, which is the chief interest of this study. As the first consideration is the development of this layer, which varies with the size of the vessel, the vessels have been divided into four groups—the small arterioles, the large arterioles, the small arteries and the large arteries.

THE DEVELOPMENT OF THE ELASTIC LAYER

Small Arterioles.—The small arterioles are found only in the substance of the brain, and they are the only arterioles which at birth do

7. Ford, F. R., and Schaeffer, A. J.: The Etiology of Infantile Acquired Hemiplegia, Arch. Neurol. & Psychiat. **18**:323 (Sept.) 1927.

8. Tuthill, C. R.: Bull. Buffalo Gen. Hosp. **7**:15, 1929.

not show an elastic layer. In subjects of 1 year the elastic fibers stain faintly, but it is not until the eighteenth month that a definite layer is present. This layer then increases in thickness up to the age of 5 years when it appears to have reached the end of its most active growth, since in the subsequent years to 14 it shows but little change in thickness.

Large Arterioles.—In the large arterioles, found chiefly in the white substance and in the meninges, a faintly staining elastic layer is present at birth, but at 4½ months the elastic layer is noticeably thicker. This increase in thickness becomes more pronounced at 1 year, 2 years and at 4 years, when growth proceeds so slowly that it appears to remain almost stationary up to 14, the age of the oldest child in this series.

Small Arteries.—The small arteries are the smaller vessels of the circle of Willis, the meninges and the basal ganglia. At birth they have a thin but sharply defined layer which grows rapidly for the first three months to a thickness that shows a scarcely perceptible increase at 14 years.

Large Arteries.—These are the large arteries of the circle of Willis and of the meninges. In them the elastic layer is much heavier at birth than that in the vessels previously discussed, but it likewise develops in three months to a thickness which increases but little throughout childhood.

Although the elastic layer unquestionably increases in thickness in the early months and years of childhood, an apparent exception was found in a child aged 3 in whom the elastic layer was not as well developed as in children a year younger. Such a lack of development of the elastic layer or even its normal condition at birth might account for the ease with which intracranial hemorrhages occur in the new-born. Further variations in the elastic tissue were looked for in the splitting of the elastic tissue in relation to the branching of the vessel. Not only does the elastic layer split at the branching of the vessel, but the splitting may also extend around the entire lumen of the vessel. In older subjects these fibers may undergo hyaline change which causes the branch to appear as an aneurysm for which they are often mistaken.

Splitting of the Elastic Layer at the Branching of the Vessel: In childhood, the elastic layer not only splits at the branches of the large vessels, as has been reported by Hackel,[2] but the smaller ones also show a suggestion of such a splitting. In the larger arteries three types of splitting occur, each type forming raised knotty areas of split elastic fibers of varying thickness and interlying long slender cells. The first and simplest type is a splitting of the elastic layer into two or three lamellae. A second type consists of a splitting of the fibers from the bordering lamella and from the subendothelial lamella or from both the subendothelial and a middle or third lamella. All the lamellae in

this type appear distinct but reduced to varying grades of thickness, separated from each other by few or numerous thin fibers and long slender cells; whereas in the third type, thin fibers split from all of the lamellae and rest above the lower or bordering one, which alone is heavy and distinct.

These three types of splitting are similar to those described by Hackel [2] in childhood, except that a third lamella was observed by him only in subjects over 20 years old. In this series, a third or middle

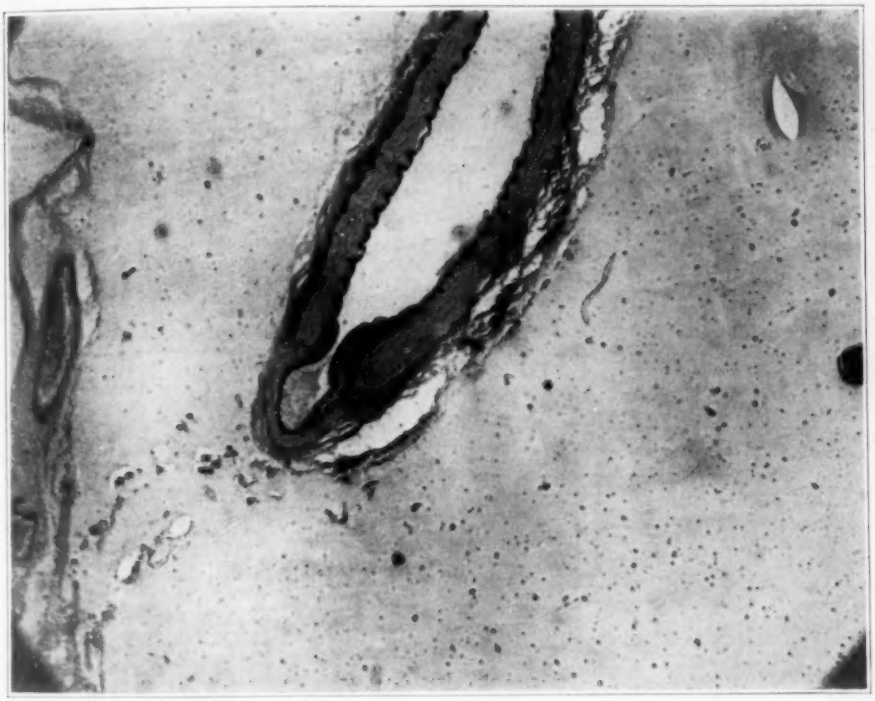

Fig. 1.—Splitting at the branching of the vessel (type 3) in a child of 6 months.

lamella, which appears to be as definite a division of the elastic layer as the other two, is frequently found to split either independently or from the subendothelial lamella. Apparently there is not a dependence on age for variations of the types of splitting, since in this series the first and third types were found in the vessels of a fetus and in persons of all ages. The second type, observed by Hackel only in children beyond the age of 6 and in adults, was found in this series in a child of 7 days as well as in older children. Also there did not appear to be a predominance of one type at any age or in any individual. As to an increase of frequency in the splitting with relation to age, it was found

that the number of vessels with split elastic fibers at the branching of the vessel is not greater in the younger children than in the older. Children of 7 months show as frequent splitting of the elastic layer as children of 11 years. This conclusion is the opposite of Hackel's, which is that variation and frequency of splitting increase with age. However, since the number of subjects in this series is twenty-six and the number in his series is eight, it seems probable that the greater the number of persons, the greater will be the similarity and frequency of the splitting of the elastic layer at any age.

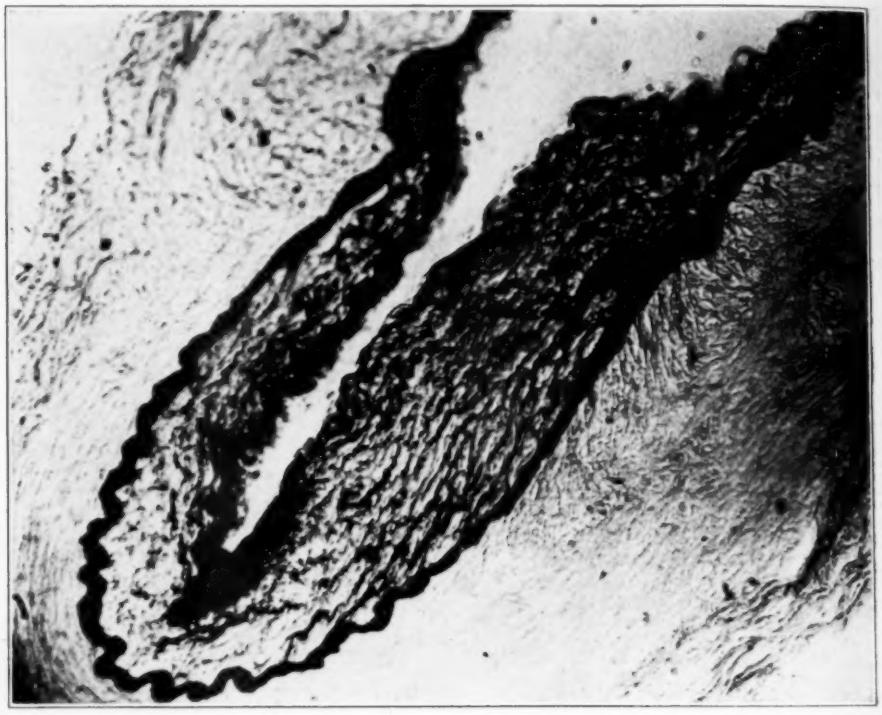

Fig. 2.—Splitting of the elastic layer extended around the lumen of the small branch in a child of 4 months.

Splitting of the Elastic Layer Before the Branching of the Vessel: This form of splitting was observed by Hackel [2] only in subjects over 20, but in my series it occurred as frequently as the splitting of the elastic layer at the branching of the vessel. The types of splitting are similar to those just described, showing likewise neither variation in type nor in frequency with age. The split fibers and the long, slender cells are found above the lower elastic lamella and projecting into the lumen of the vessel, forming areas that are either high and narrow or

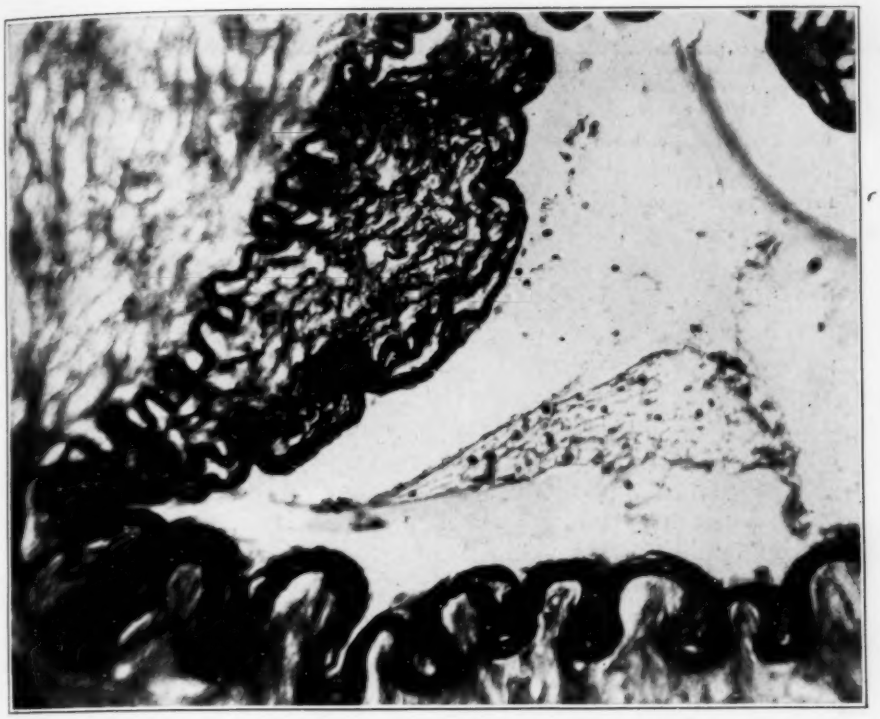

Fig. 3.—Splitting of the elastic layer before the branching of the vessel (type 2) in a child of 7 months. Three heavy lamellae are visible.

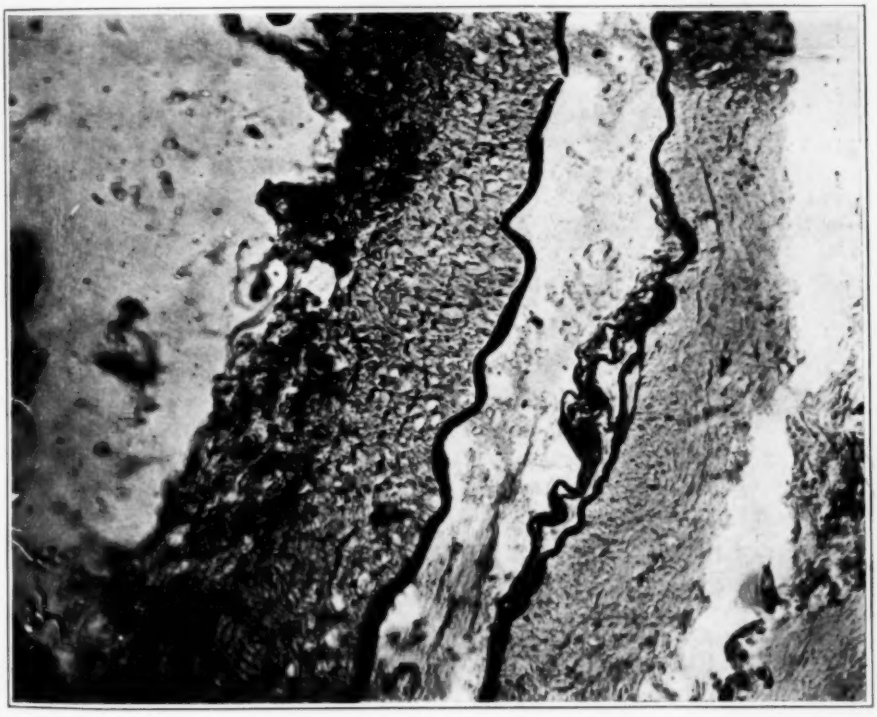

Fig. 4.—Splitting of the elastic layer before the branching of the vessel (type 3) in a fetus of 8 months.

low and long; the former is the most common, although both forms are found in vessels of one individual. Beneath these areas the cells of the media turn upward instead of running longitudinally, thus indicating that a branching of the vessel will occur near this point, which can be verified in most instances in the next few sections. Occasionally, areas of split fibers are found on both sides of the lumen of the vessel.

The areas of split elastic fibers at the branching of the vessel and presumably those before the branching of the vessel are considered by Thoma [3] to be due to the force of the blood stream at these points, especially in the cerebral vessels where the media is thin. He expressed the belief that these knotty areas are arteriosclerotic and that retrogressive changes appear in them, particularly calcification which forms at the junction of the media and the elastic layer, the region most affected by high pressure. Since these areas of split elastic fibers are present from birth, they can scarcely be called arteriosclerotic. It is, of course, possible that they are produced in fetal life by the pressure of the blood stream at the branching of the vessel. As to calcification in such an area, one instance of this was found in the basilar artery of a child aged 7 years with an occipital abscess of four month's duration. In this case it seemed as probable that the calcification was due to the effect of the chronic inflammation as that it was due to an increased intracranial blood pressure from the occipital abscess.

CASE 1.—The child, aged 7, had a previous history of measles, whooping cough and varicella. Four months before admission to the hospital, she had been ill with "flu," and two weeks later had a similar attack. Following these attacks, a headache of seven weeks' duration developed. The headache disappeared for a month and then recurred. It became increasingly worse, and was followed by flaccid paralysis of the left side and rigidity of the neck. The child entered the hospital and died on the next day. Basilar meningitis and an abscess of the right occipital lobe were found at autopsy. In the basilar artery, a calcified area at the junction of the media and elastic layer was found in a raised area of split elastic fibers before the branching of the vessel.

Splitting of the Elastic Layer Without Relation to the Branching of the Vessel: In six cases, raised areas in the intima of split elastic fibers, interlying long slender cells and connective tissue were found. Except for the presence of connective tissue, these areas were similar to those described for the third type of splitting of the elastic layer at and before the branching of the vessel. The areas under discussion, however, persisted for a long distance in the intima, forming high or low projections into the lumen. Beneath them the cells of the media ran longitudinally in contradistinction to the upward turning of the cells of the media beneath the split fibers before the branching of the vessel.

Fig. 5.—Calcified area in the split elastic fibers before the branching of the vessel in a child of 7 years with an occipital abscess of four months' duration.

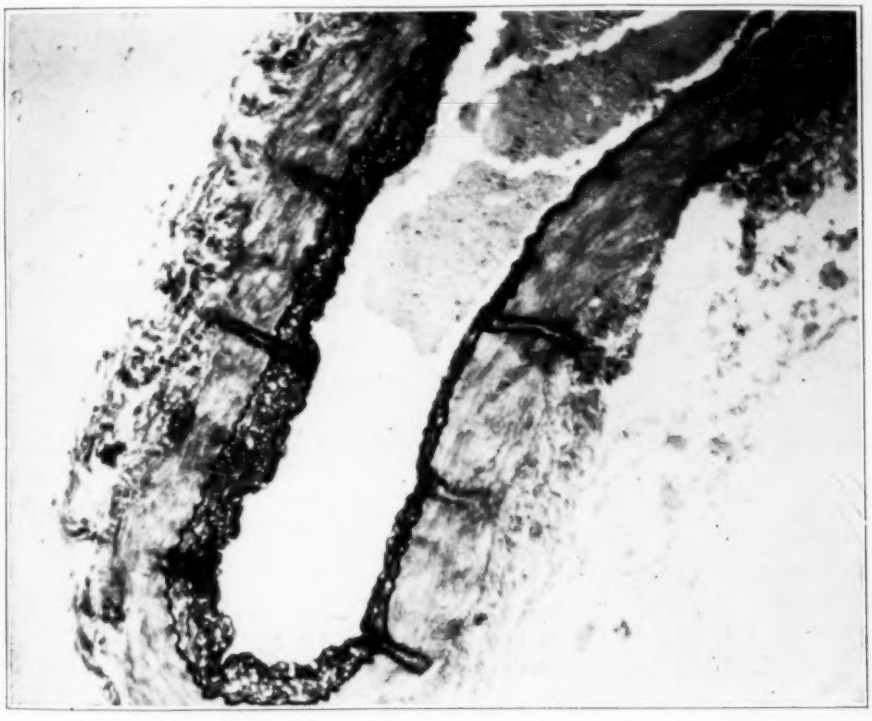

Fig. 6.—Area of split elastic fibers and connective tissue without relation to the branching of the vessel in a child of 5 months with pyloric stenosis.

Case 2.—A previously healthy boy, aged 20 months, fell to the floor, striking the top of his head. Drowsiness and convulsions followed after several hours. At the hospital on the next day, a meningeal blood clot was removed at operation, but the child did not recover consciousness.

Case 3.—A girl, aged 11 years, whose previous illnesses were whooping cough, measles and varicella, became ill with coryza on the day following vaccination for smallpox. Symptoms of sinusitis, meningitis and pneumonia followed in rapid succession, and the child died in ten days.

Case 4.—The next case in this group was that of a boy who had been operated on at 5 weeks of age for a strangulated hernia. At 5 months of age he again entered

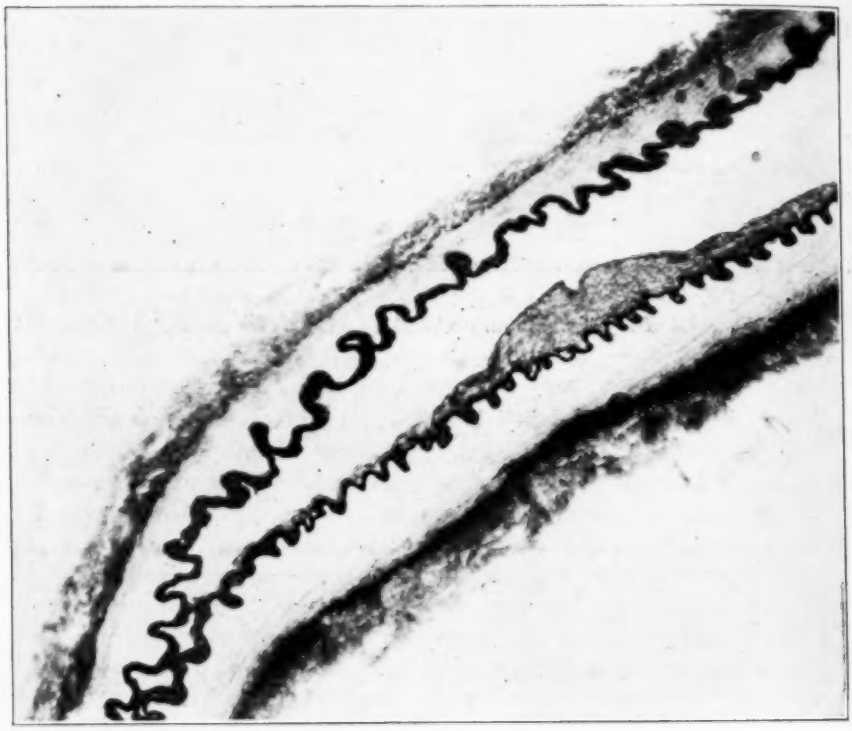

Fig. 7.—Area of split elastic fibers and connective tissue without relation to the branching of the vessel in a child of 2 years with meningitis.

the hospital because of vomiting and undernourishment from pyloric stenosis. Three days after admission, he died of an interstitial pneumonia.

Case 5.—The fourth case in this group was that of a child, aged 2 years, with a past history of measles and whooping cough. He suddenly became ill with vomiting and convulsions. Death occurred in three days from meningitis caused by the bacillus of Pfeiffer.

Case 6.—The fifth case in this group was that of a child with hydrocephalus, who had been a patient at the hospital since birth. When 7 months of age, he died from an abscess at the site of a ventricular tapping and from bronchopneumonia.

CASE 7.—The sixth case of the group was that of a previously healthy child, aged 6 months, who died in two days from meningococcus meningitis.

Although the intimal growths of the cerebral vessels in these six cases are similar to the lesions of the intima described by Rhea [5] (one vessel), Ford and Schaeffer [7] and myself,[8] it is now difficult to determine whether or not they are pathologic lesions, developmental anomalies of the elastic layer, or lesions related to the splitting of the elastic layer at the branching of the vessel. If they are pathologic, they are not similar to other vascular lesions, inflammatory or arteriosclerotic. There is no evidence of inflammation in these vessels. As to arteriosclerosis, Jores [9] was unable to say whether or not a growth of connective tissue and elastic fibers in the intima constitutes arteriosclerosis when fat is not present. It was the belief of Hueck [10] and Aschoff [11] that hyperplasia of the elastic layer in the intima with connective tissue is a presenile arteriosclerosis, although they did not mention such hyperplasia in the vessels of children.

Proof as to whether or not the areas in the intima are developmental anomalies of the elastic layer is of necessity lacking. From the histories in the six cases, it would seem that the areas described in the intima might be due to the effects of intoxication or infection. However, Wiesel [12] and Scharpff [13] studied the effect of infectious diseases on the aorta and its branches and came to the conclusion that the media is chiefly affected. They observed necrosis of the muscle fibers, which later resulted in scarring and calcification. Lesions of the media were not demonstrable in the cerebral vessels in my cases, but since the cerebral vessels are of the muscular type and the vessels studied by Wiesel and Scharpff are of the elastic type, the type of vessel may determine which wall is most susceptible to infection and intoxication. Therefore, since, in the cerebral vessels, it is the elastic layer which under stress calcifies or degenerates into hyaline, it is possible that intoxication and infection result in the formation of raised areas of split fibers from this layer.

A further consideration is the fact that, since the elastic layer is continuously growing in childhood, it is perhaps especially sensitive during that time to the influence of intoxication and infection. This appears to be probable in these cases, in which the patients were with one exception under 2 years, the time of most active growth of the

9. Jores, L.: in Henke and Lubarsch: Handbuch der speziellen Anatomie und Histologie, Berlin, Julius Springer, 1924.

10. Hueck, W.: München. med. Wchnschr. **67**:535, 573 and 606, 1920.

11. Aschoff, quoted by Jores (footnote 9).

12. Wiesel, J.: Ztschr. f. Heilk. **26**:107, 1905; **27**:262, 1906; Wien. klin. Wchnschr. **18**:1393, 1905; **19**:793, 1906.

13. Scharpff, A.: Frankfurt. Ztschr. f. Path. **2**:391, 1909.

elastic layer. Also, with one exception, in all of these cases there was a meningitis of some kind, which suggested that the vascular changes might likewise be part of a mesodermal activity.

The similarity of the raised areas described to the splitting of the elastic tissue before, and at the branching of, the vessel (although a branching could not be demonstrated in long serial sections) indicates that they are the same. But since the areas of split elastic fibers before the branching of the vessel are short, whereas the areas under discussion persist for long distances, it seems probable that the overgrowth of the latter may be due to the effect of inflammation and intoxication. The chief pathologic significance of these areas is the possible resulting circulatory disturbance and the formation of thrombi, as demonstrated in the case of Ford and Schaeffer [7] and in the case of lead poisoning.[8]

SUMMARY AND CONCLUSIONS

In a study of the cerebral vessels of two stillborn fetuses and of twenty-four children, varying in age from birth to 14 years, it was observed for the first time that the size of the vessel determines the presence and the thickness of the elastic layer at birth and also the period of its most active growth. For the large vessels this period is the first three months, whereas for the smaller ones it is for the first five years, although the elastic layer continues to grow throughout childhood.

Splitting of the elastic layer into knotty areas of elastic fibers or lamella and long slender cells is present at birth; it is found near the branching of the vessel. Three types of splitting were observed, varying in frequency and in type according to the individual rather than to age.

Retrogressive changes occur in these areas even in childhood, as calcification was found in the split elastic fibers in a child of 7 years with an occipital abscess of four months' duration. In six cases, raised areas of split elastic fibers, connective tissue and long slender cells were observed for long distances in the intima without apparent relation to the branching of the vessel. However, the similarity of these six areas to the split elastic fibers before and at the branching of the vessel, indicates that they represent a similar process of growth but that, probably owing to the influence of intoxication and inflammation, the splitting of the elastic layer has increased.

THE OLIGODENDROGLIOMAS

A CLINICOPATHOLOGIC STUDY *

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The demonstration of the participation of the oligodendroglia in the formation of gliomas of the brain was first made by Bailey and Cushing.[1] Following the discovery of the oligodendroglia by del Rio-Hortega [2], Bailey and Hiller [3] expressed the idea that certain tumors of which they had examples "must be composed of oligodendroglia." However, it was Bailey and Cushing who first separated these tumors into a definite entity and classified them as oligodendrogliomas. These tumors, as they pointed out, had certain well defined morphologic characteristics which seemed so uniform that they could be diagnosed with simple routine stains. These authors were supported in their conception by reports of similar neoplasms by Dickson,[4] Schaffer [5] and Thomas and Jumentié.[6] Nevertheless, while in general appearance the tumors and the tumor cells seemed to resemble the oligodendroglia cells in the gray and white matter of the brain, there was some skepticism about the actual existence of these tumors as an entity because of the failure of any one to impregnate successfully the constituent elements of which these tumors must be composed, namely, adult oligodendroglia. It remained for Bailey and Bucy [7], in an excellent contribution, to

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* From the Neurosurgical Clinic and Neurosurgical Laboratory of Dr. C. H. Frazier, University Hospital.

1. Bailey, P., and Cushing, H.: A Classification of the Tumors of the Glioma Group on a Histogenic Basis with a Correlated Study of Prognosis, Philadelphia, J. B. Lippincott, 1926.

2. del Rio-Hortega, P.: Estudios sobre la neuroglia: La glia de escasas radiaciones (oligodendroglia), Bol. r. Soc. españ. de hist. nat. **10**:63 (Jan.) 1921.

3. Bailey, P., and Hiller, G.: The Interstitial Tissues of the Nervous System: A Review, J. Nerv. & Ment. Dis. **59**:337 (April) 1924.

4. Dickson, W. E. C.: Oligodendroglioma of Floor of Third Ventricle, Brain **49**:578, 1926.

5. Schaffer, K.: Bemerkungen zur Histopathologie des Hirngliome, Monatschr. f. Psychiat. u. Neurol. **65**:208, 1927.

6. Thomas, André, and Jumentié, J.: Un cas du tumeur du ventricule latéral, Rev. neurol. **2**:202, 1928.

7. Bailey, P., and Bucy, Paul C.: Oligodendrogliomas of the Brain, J. Path. & Bact. **32**:735, 1929.

show that these tumors are composed in reality of oligodendroglia cells, and to demonstrate these cells with their processes in ten of thirteen oligodendrogliomas which they reported. They demonstrated that the cells which compose these oligodendrogliomas are in reality oligodendroglia cells, and that specific silver impregnation shows them to have the same characteristics as the normal oligodendroglia cells of del Rio-Hortega.

The oligodendrogliomas, a description of which was first given by Bailey and Cushing and later elaborated by Bailey and Bucy, are exceedingly cellular tumors which present a uniform appearance by the usual routine stains. They possess small, round nuclei which rarely show mitoses, an indistinct, granular cytoplasm, fibrillary intercellular material which tends to "box-in" each cell and a moderate number of vessels. They tend to show calcification almost without exception, and by proper impregnations are seen to be composed of oligodendrocytes among which are scattered astrocytes in varying numbers. In addition, these tumors tend to grow slowly and to show areas of necrosis and, in rare instances, nerve fibers running through them, the remnants probably of the invaded tissue of the brain. They invade the tissue and are but poorly defined from the normal cerebral structure. Nevertheless, the transition between brain and tumor is often sharp.

THE OLIGODENDROGLIA

The oligodendroglia was one of two structures isolated by del Rio-Hortega [2] from the so-called "third element," the other structure being the microglia. The existence of this element was confirmed by Penfield. In a series of brilliant contributions culminating in a comprehensive monograph published in 1928, del Rio-Hortega [9] made clear the structure of these neurologic elements. They are present in both gray and white matter of the cerebrum, in the former as the perineuronal satellites and in the latter along the axis cylinders and myelin sheaths. In his last contribution, del Rio-Hortega has shown that their size may vary greatly. They are smallest in the cortex and largest at the base of the brain, where they accompany the largest axis cylinders. They have a small nucleus, and their cytoplasm as seen in silver impregnations is composed of a number of processes that branch dichotomously and possess a condensation of the cytoplasm at each dichotomy. The processes often branch off at right angles from the cell in order to

8. Reference deleted by author.

9. del Rio-Hortega, P.: Tercera aportación al conocimiento morfologico e interpretación funcional de la oligodendroglia, Mem. r. Soc. españ. de hist. nat. **14**:1, 1928.

follow along the nerve fibers, and they twine their processes around the axis cylinder and its sheath like a vine around the trunk of a tree. The oligogliocytes contain a centrosome, gliosomes and a Golgi apparatus. Cajal [10] first suggested, and del Rio-Hortega [11] agreed, that these cells are similar in function to the cells of the sheath of Schwann, and that their function consists in the formation of myelin in the myelin sheath. They are most numerous at the time of myelinization. Del Rio-Hortega believes that these cells are of ectodermal origin. Between them and the astrocytes are numerous transition forms, the so-called "dwarf cells" and other oligoglio-astrocytic forms. This has been pointed out by del Rio-Hortega and by Penfield [12]. The functional significance of these transitional forms is not clear, but their relationship morphologically to both oligogliocytes and astrocytes seems beyond dispute.

Like other entities, the oligogliocytes exhibit changes peculiar to themselves. Penfield and Cone [13] have shown that they undergo a regressive change, which they have described as acute swelling of the oligodendroglia, and which occurs in toxic-infectious conditions, trauma, cerebral scars and other disease states, as well as post mortem. This change is characterized by a swelling and rarefaction of the cytoplasm, a pyknosis of the nucleus and a loss of the cell processes. Another degenerative change has been described in the formation of mucocytes (Pélissier), which have been identified with degenerated oligogliocytes by Bailey and Schaltenbrand,[14] Ferraro [15] and Grinker and Stevens.[16] Further indirect proof of the existence of the oligodendroglia as an entity now comes in the demonstration that certain gliomas of the brain are composed practically entirely of these oligogliocytes, and that the characteristics of these cells in the tumor are similar to those in the normal tissue of the brain.

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10. Ramón y Cajal, S.: Contribución al conocimiento de la neuroglia del cerebro humano, Trav. du lab. de recherches biol. de l'Univ. de Madrid **11**:255 (March) 1914.

11. del Rio-Hortega, P.: Son homologables la clia de escasas radiaciones y la celula de schwann? Bol. Soc. españ. de biol. **10**:1, 1922.

12. Penfield, Wilder: Oligodendroglia and its Relation to Classical Neuroglia, Brain **47**:430, 1924.

13. Penfield, Wilder, and Cone, W.: Acute Swelling of Oligodendroglia, Arch. Neurol. & Psychiat. **16**:131 (Aug.) 1926.

14. Bailey, P., and Schaltenbrand, G.: Die muköse Degeneration der Oligodendroglia, Deutsche Ztschr. f. Nervenh. **97**:231, 1927.

15. Ferraro, A.: Acute Swelling of the Oligodendroglia and Grapelike Areas of Disintegration, Arch. Neurol. & Psychiat. **20**:1065 (Nov.) 1928.

16. Grinker, R., and Stevens, E.: Mucoid Degeneration of the Oligodendroglia and the Formation of Free Mucin in the Brain, Arch. Path. **8**:171 (Aug.) 1929.

REPORTS OF OLIGODENDROGLIOMAS

The pioneer reports of Bailey and Cushing and of Bailey and Bucy have already been referred to. A few other reports of oligodendrogliomas have appeared in response to the stimulus created by the description of the former. Dickson has reported an oligodendroglioma arising from the floor of the third ventricle. The tumor lay in the interpeduncular space, producing a marked internal hydrocephalus. Microscopically, it was composed of small cells, with dense, spherical nuclei surrounded by indefinite, feebly staining cytoplasm. The tumor conformed to the description given by Bailey and Cushing, but no impregnation of oligodendroglia was made. This is the only instance of an oligodendroglioma occurring at the base of the brain. All other cases that have been recorded have been in the hemispheres. Schaffer reported what he called an adendroglioma which was presumably composed of oligodendroglia, since in his conception the oligodendroglia are derived from the apolar spongioblasts that take origin from the primitive spongioblasts derived from the germinal cells of His. These adendrogliomas are composed of small, uniform cells with a smooth, homogeneous cytoplasm. Schaffer did not demonstrate that these cells were oligogliocytes, since he seems not to have used the silver method in his studies. Another oligodendroglioma has recently been found by Bailey and Bucy in a report by Thomas and Jumentié.

Recently, Roussy, Lhermitte and Oberling [17] included in their "gliomes à petites cellules" the group of tumors that Bailey and Bucy recently described as oligodendrogliomas. Apparently, they considered these tumors as merely a subgroup in their classification of "gliomes à petites cellules," but it is extremely difficult to see wherein the two differ very much.

TECHNIC

In an investigation the success of which depends so much on technic, we believe that a few words with regard to our technical method are in order. All of our material was fixed in formaldehyde; the original method of del Rio-Hortega was not possible for the demonstration of oligodendroglia. We therefore made use of Penfield's modification of this method. Our best results were obtained by the use of a mixture composed of equal parts of pyridine, ammonia and water, instead of the strong ammonia used to deformaldehydize the tissue. With sections placed in this mixture at room temperature, over night, we obtained excellent impregnations of oligogliocytes in the tumor when strong ammonia alone failed. Various types of silver carbonate were used, including that made by del Rio-Hortega's formula and lithium carbonate. The most satisfactory silver solution, for our purposes at least, was that prepared according to Kubie's method. We found that

17. Roussy, G.; Lhermitte, J., and Oberling, C.: Le névroglie et ses réactions pathologiques, Rev. neurol. **1**:878 (June) 1930.

often reduction in 0.5 per cent of liquor formaldehyde instead of the usual 1 per cent, gave clear pictures of the cells.

The tissues of only two of our four cases were available for exhaustive study. In both of these cases, however, we were able to impregnate oligogliocytes and to identify them conclusively as oligodendrogliomas. The structure in the two remaining cases was so typical that, although the diagnosis was not confirmed by specific impregnation, we believed that we were justified in including them in our series.

In addition to the specific impregnation mentioned, we made use of Globus' modification of Cajal's gold chloride method, del Rio-Hortega's lithium carbonate method, del Rio-Hortega's method for nuclear connective tissue and nerve fiber impregnation, del Rio-Hortega's first variant of Achucarro's method, Perdrau's method, Bielschowsky's impregnation, and the usual hematoxylin-eosin, phosphotungstic acid-hematoxylin, aniline blue and van Gieson stains. Fat stains were made, but because of the age of the material were not successful.

REPORT OF CASES

CASE 1.—*Tumor of the anterior portion of the right cerebral hemisphere. Craniotomy in November, 1927. Exposure of tumor and subtemporal decompression. Evacuation of gliomatous cyst in June, 1928. Attempted establishment of communication between the lateral ventricles in January, 1930. Death. Confirmation of observations by necropsy. Identification of oligodendroglioma by histologic examination.*

History.—B. G., a Jewish woman, aged 25, was transferred from the neurologic service of Dr. W. G. Spiller to the neurosurgical service of the University Hospital on Sept. 26, 1927. Her principal complaints were headache and diplopia. Her mother and two aunts had died of tuberculosis. The patient had had an appendectomy in 1922, and later in the same year a salpingectomy was performed, and a tuberculous salpingitis was found. At the time of the latter operation, she had had a transitory attack of blindness in the left eye from which she made a rapid and complete recovery. The visual trouble was attributed to a toxic choroiditis. The present illness began in January, 1927, about nine months before admission, with severe headache that began in the occipital region and radiated along the right side of the head to the temporal region and the right side of the face. For two weeks before entrance, the headache had not been quite so severe. In the middle of April, 1927, she became drowsy and slept a good deal, day and night. A short time later she had diplopia, which had persisted until her entrance into the hospital. With the onset of double vision, she became dizzy when moving around and had difficulty in finding where to put her feet in walking. There was no buzzing in the ears, and hearing was normal.

Physical Examination.—The patient was well nourished, well educated and cooperative; she was not acutely ill, but was suffering from intense headache. The head and scalp were normal, there being no deformity or swelling. The heart was normal. The lungs showed prolonged breath sounds at the apexes and a few râles at the base posteriorly. There was a scar of a large right rectus incision. Generalized abdominal tenderness was present, but there was no palpable organ or mass.

Neurologic Examination.—The patient was mentally clear and intelligent. The olfactory sense was normal. Vision was 6/15 in the right eye and 6/20 in the left. Examination of the visual fields showed a beginning left homonymous

superior quadrantanopia. The pupils were unequal in size, the right being the smaller; their reaction, however, was normal. There was no ophthalmoplegia, in spite of the complaint of diplopia. Examination of the fundi revealed no exudate and no hemorrhage, but there was 2 diopters of choking in each disk.

There was hyperesthesia in the distribution of the right trigeminus. The facial innervation was normal. Hearing was normal. A loss of sense of taste in the posterior one third of the tongue was noted. The tongue protruded in the midline; no atrophy or tremor was found. Otherwise, the cranial nerves were normal.

The Romberg test was positive, the patient falling to the left and backward. She was unsteady on either foot, and she performed the heel and toe walking test unsteadily. In the finger-to-nose test the left hand was uncertain and often hypermetric, while the right hand was normal. There was no past pointing. Dysdiadokokinesia was definitely present in the left hand and absent in the right.

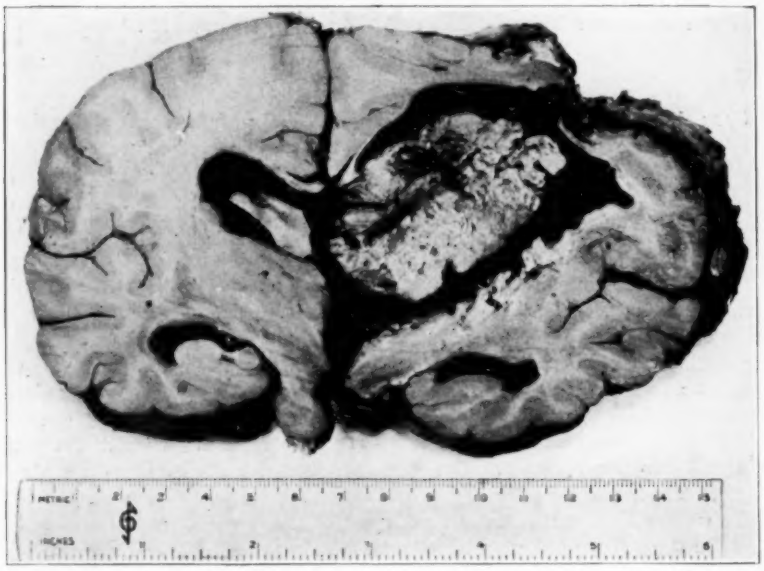

Fig. 1 (case 1).—Oligodendroglioma occupying a large part of the right hemisphere. Note the close relationship to the septum pellucidum and the corpus callosum.

Nystagmus was not constantly present; only one or two short jerks on left lateral gaze were noted. Stereognosis was partially impaired in the left hand, the patient being unable to distinguish pieces of coin, but she was able to recognize a pen and a finger. There was loss of position sense in the left hand and foot, with preservation of this sense on the right. No marked changes were noted in the motor system. A dynamometer test gave 50 as pressure for the right hand and 30 for the left, the patient being right-handed.

The corneal reflexes were equally active; the biceps and triceps jerks were equal and normal. The patellar and achilles reflexes were bilaterally very active. No pathologic reflexes were present.

Lumbar puncture was performed on Sept. 30, 1927. The pressure, in the horizontal position, registered 16 mm. of mercury, corresponding to 208 mm. of

water. On jugular compression, it rose to 24 mm. of mercury and fell promptly to the original height. The fluid was clear and colorless, and contained 2 lymphocytes and 2 polymorphonuclear leukocytes. No increase of protein was found. As the pressure was high, no fluid was taken for serologic study.

A Bárány test indicated a lesion above the tentorium. Roentgen examination of the skull showed evidence of an extrasellar lesion, with atrophy of the dorsum sellae and posterior clinoid processes. No calcification was seen. Other routine laboratory tests of the urine and blood gave negative results.

Course.—During a period of ten days under observation, the patient experienced considerable improvement. The headache became less severe and the choked

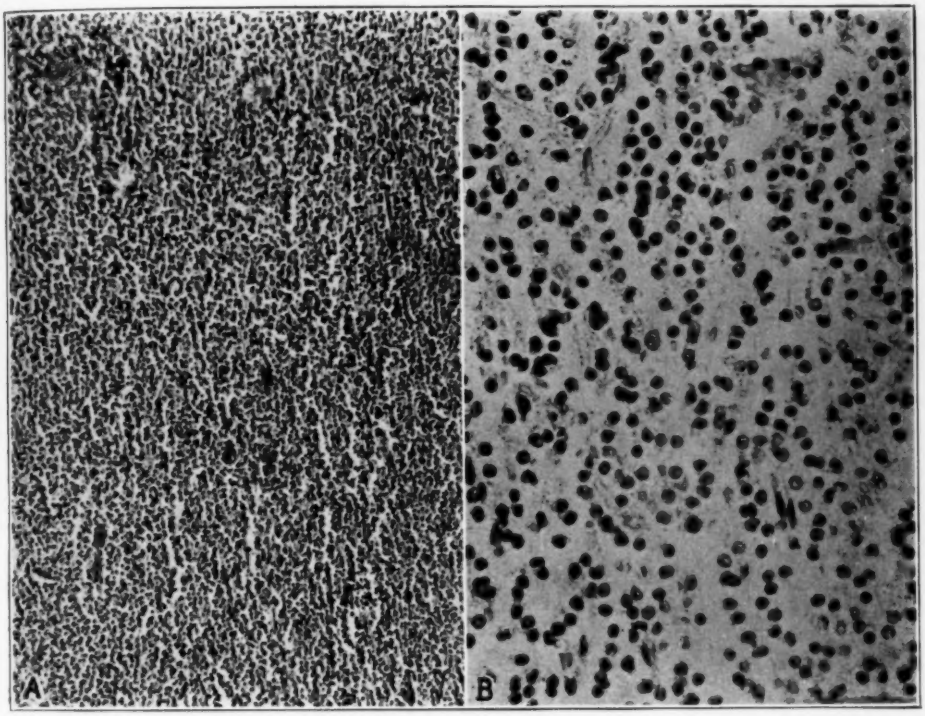

Fig. 2.—View of the general architecture of the tumor. *A*, low power view; × 82. *B*, high power view of the same tumor; × 373. Hematoxylin and eosin stain.

disk subsided to 1 diopter. Although she was thought to have a neoplasm in the right middle fossa, the localization was by no means absolutely certain. In view of the history of tuberculosis in the family and in the patient (tuberculous salpingitis), it was thought not unlikely that the lesion might be a tuberculoma. At any rate, the case was classified as a "tumor suspect," and the patient was advised to go home for a month and await developments.

Second Admission.—On Nov. 1, 1927, twenty-six days after discharge, the patient returned for further study. There had been very little change in the condition. The headache on the right side still persisted. There had not been any loss of consciousness, nor had convulsions been present. She had not vomited.

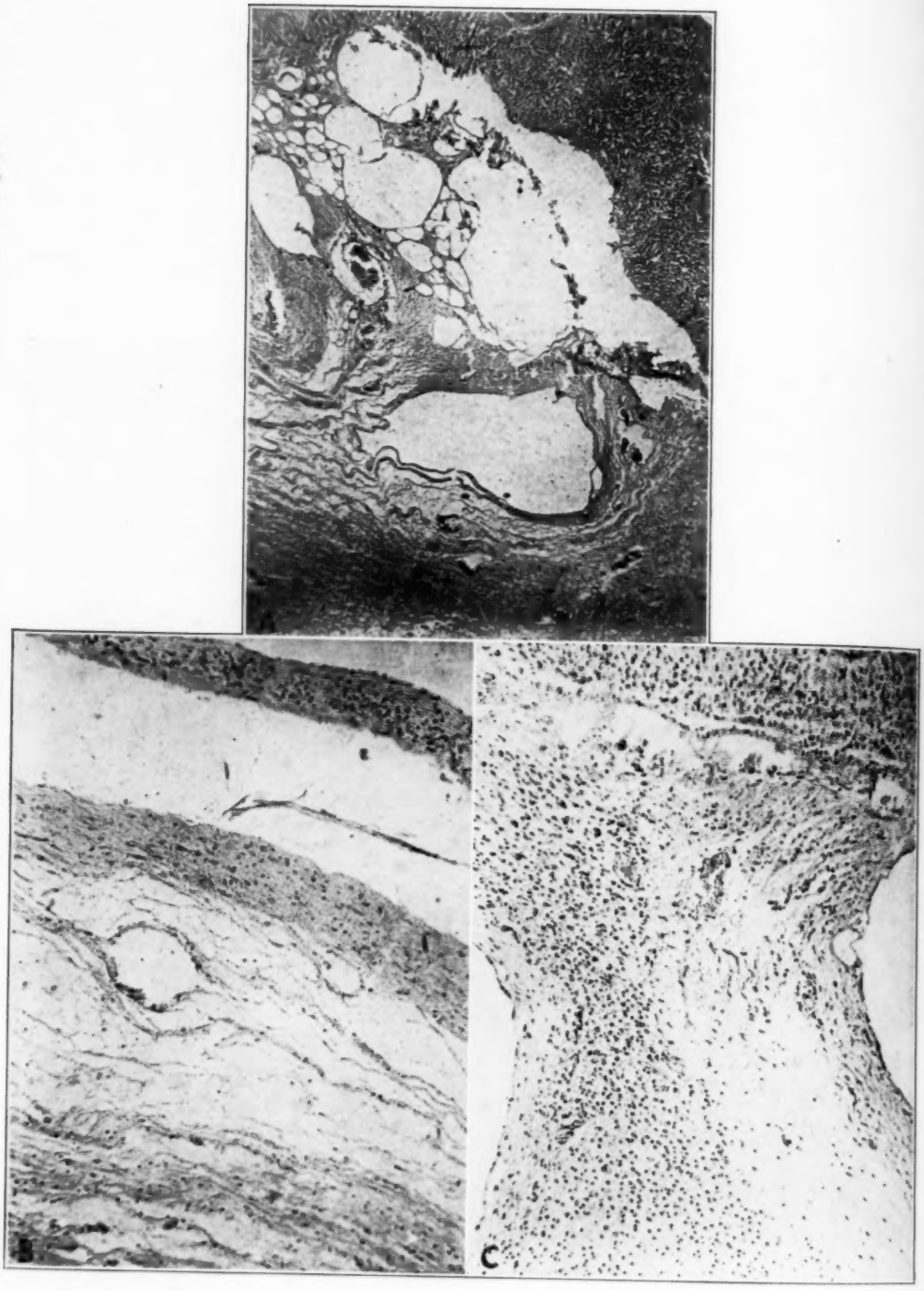

Fig. 3.—*A*, low power view to show the attempt on the part of the brain to form a wall between it and the tumor; × 25. *B*, high power view of the same process; × 82. *C*, extension of the tumor cells along part of the wall and invasion of the brain by the tumor; × 82. Hematoxylin and eosin stain.

Repeated examinations revealed the following positive observations: a tendency to drowsiness if left alone, a slight but definite weakness of the left arm and leg, inequality of the pupils with loss of reaction to light but preservation of reaction in accommodation, decreased vision—6/30 in the left eye and 6/12 in the right—hyperesthesia of the right side of the head, face and neck, a superior quadrantanopia on the left, unsteadiness of station and gait, exaggeration of the left patellar reflex and a Babinski sign on the left side.

Lumbar puncture revealed a pressure of 18 mm. of mercury (234 mm. of water) in the horizontal position. There was papilledema of 1 diopter in the right eye and of 1.5 diopters in the left.

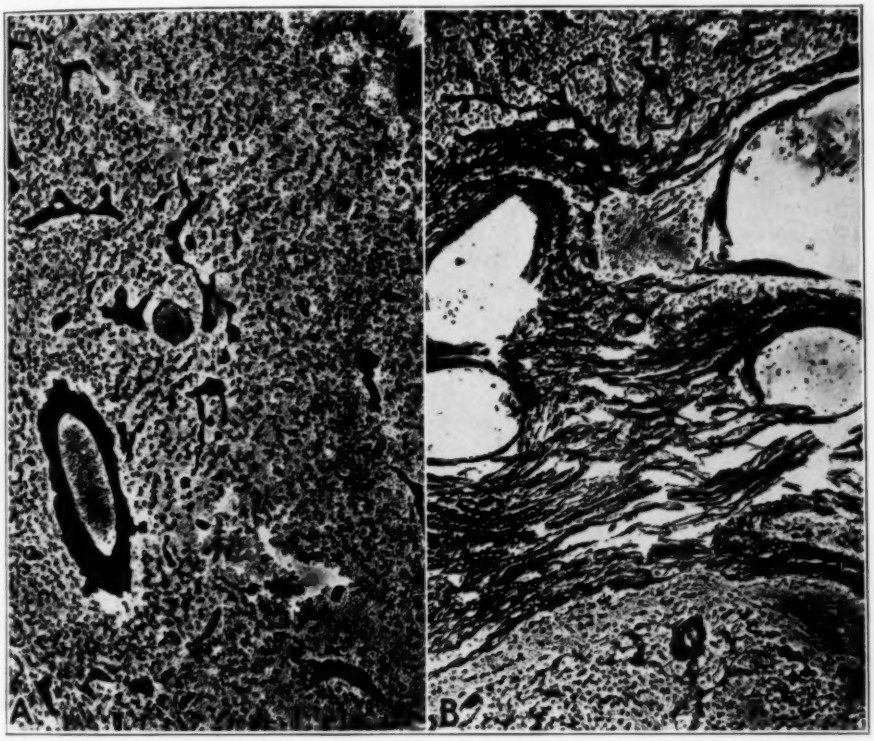

Fig. 4.—Oligodendroglioma. *A*, scattered connective tissue islands in the tumor; × 82. *B*, one of the islands under higher magnification; × 373. Silver carbonate method of del Rio-Hortega.

Operation.—A ventriculogram was performed on Nov. 19; 40 cc. of fluid was collected from the right lateral ventricle and 37 cc. from the left. Dye injected into the right ventricle failed to appear in the left. The plates revealed dilatation of the lateral ventricles with distortion of the right anterior horn. The third ventricle was not outlined. A diagnosis of a lesion deforming the anterior horn of the right lateral ventricle was made from the ventriculograms. On Nov. 20, Dr. Frazier explored through a right transfrontal osteoplastic flap. A cannula was introduced toward the anterior horn and evacuated from 5 to 10 cc. of yellow fluid which partially coagulated on standing. A transcortical incision was made,

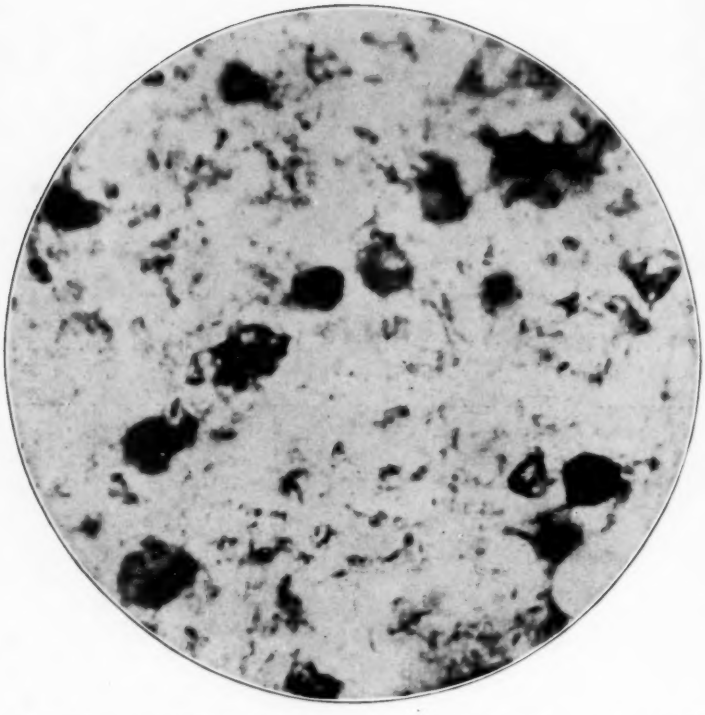

Fig. 5.—Oligodendroglioma. There are a number of small oligodendroglia cells showing fine processes. Silver carbonate method of del Rio-Hortega; × 1,665.

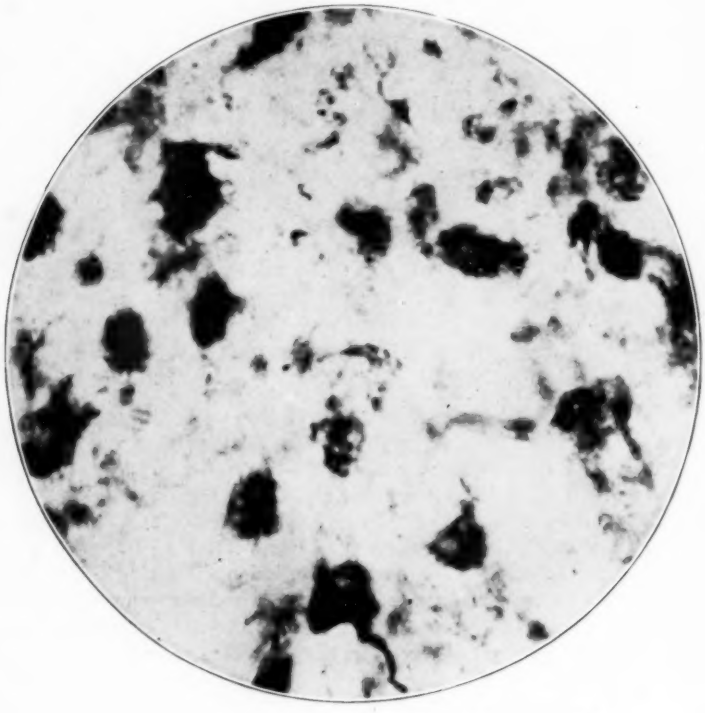

Fig. 6—Same as figure 5.

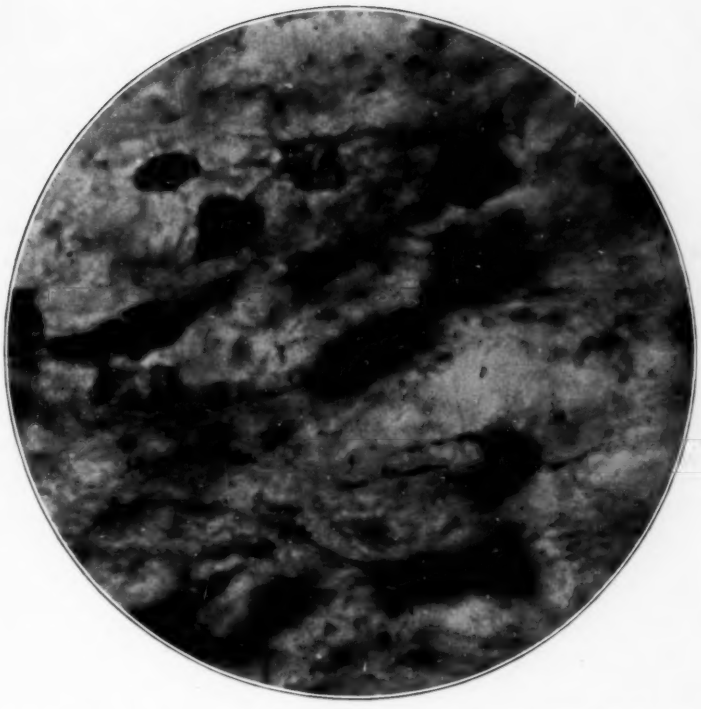

Fig. 7.—Oligodendroglioma, showing oligodendroglia cells with their processes. Silver carbonate method of del Rio-Hortega; × 1,665.

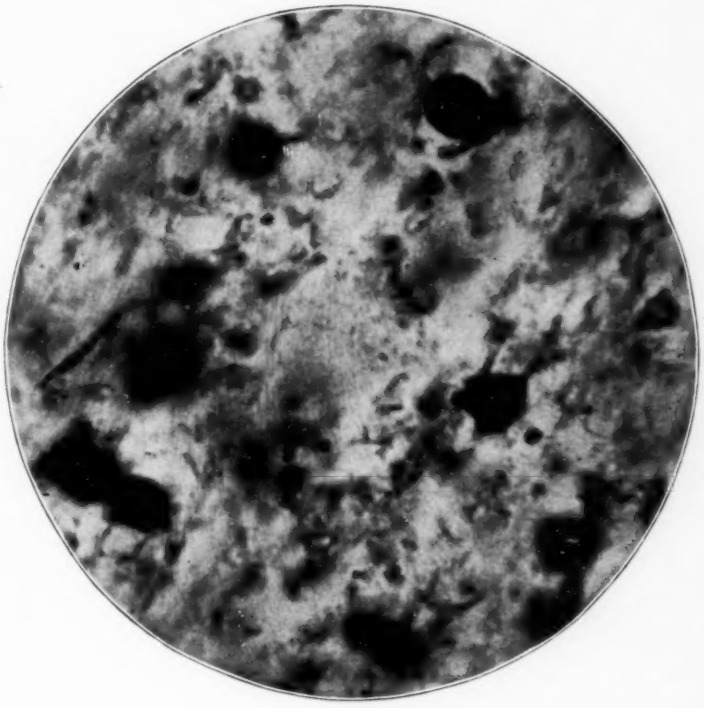

Fig. 8.—Same as figure 7.

and the lateral ventricle was opened. There was no tumor in the anterior horn as was expected. However, about the middle of the lateral ventricle and on its floor, a rather soft, grayish tissue, which might have been a glioma, was found. It did not seem desirable to incise this mass at this stage, and the exploration was concluded. A subtemporal decompression was done, and the wound was closed.

The immediate recovery was uneventful. It was not until twelve days afterward that a left-sided hemiparesis with pain in the left arm was noted. The weakness became more pronounced during the next twenty-four hours. However, by means of lumbar puncture the tension of the flap was controlled. The patient was discharged in December, 1927, with a moderate left hemiparesis, a slight left-sided hypesthesia, astereognosis of the left hand, vision of 6/30 in the right eye and 6/60 in the left, and totally flat optic disks.

Third Admission.—The patient was readmitted to the hospital on April 24, 1928, four months after the last discharge. On the whole, there had not been much

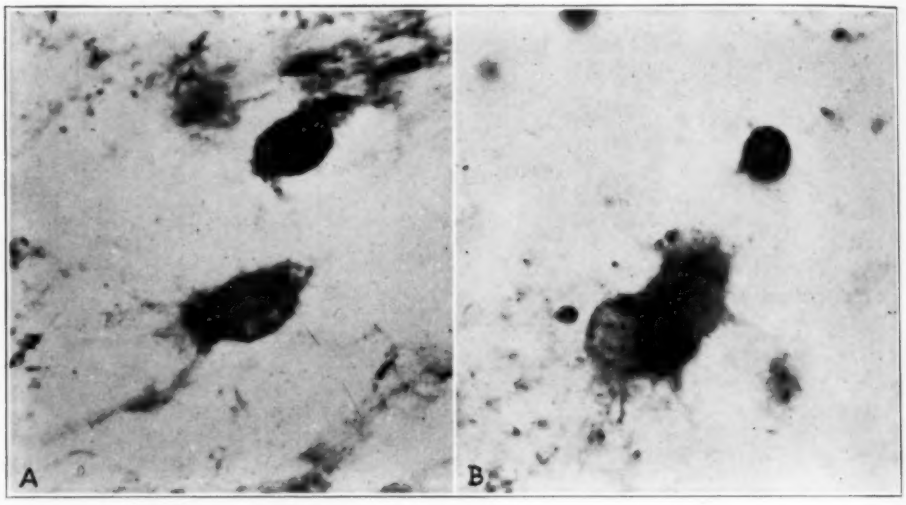

Fig. 9.—Oligodendroglioma. *A*, one of the oligogliocytes of which the tumor was composed. *B*, a similar cell, probably representing a transitional type between an oligogliocyte and an astrocyte. Silver carbonate method of del Rio-Hortega; × 1,665.

change in the condition. Mentally, she was usually bright and cooperative, although at times she became dull. She had not had convulsions or vomiting. She had occipital headache and a drawing-up sensation over the skin of the subtemporal decompression. Physically, she had been well, having gained 26 pounds (11.8 Kg.). She still had the left hemiparesis and hemiplegia, loss of sense of position in the left extremities and exaggerated reflexes, with a positive Babinski sign on the left. The tension in the subtemporal decompression varied considerably and at times was definitely high. The physiologic cups of the fundi were filled, but showed no elevation. The visual fields showed definite left homonymous hemianopia. In order to study the relationship of the tumor with the ventricles, it was decided to demonstrate the ventricles, not with the injection of air, but by the introduction of an emulsion of 2 cc. of iodized oil into each ventricle. This

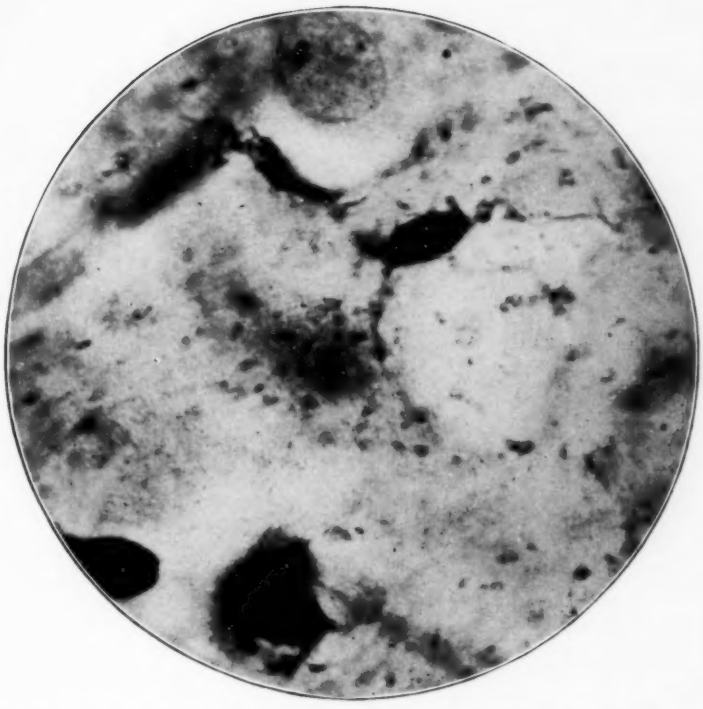

Fig. 10.—Oligodendroglioma, showing one of the oligodendrogliocytes in the tumor. Silver carbonate method of del Rio-Hortega; × 1,665.

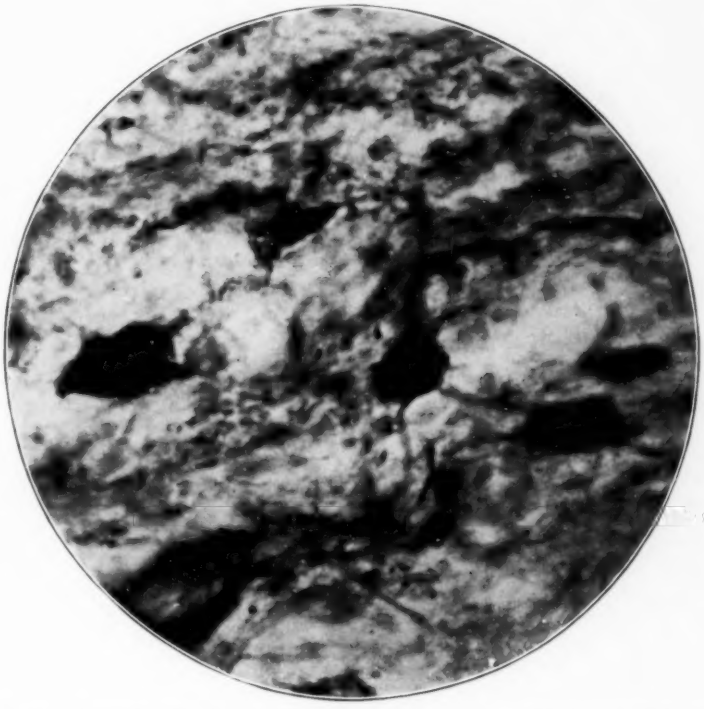

Fig. 11.—Several oligodendrogliocytes in the tumor. Silver carbonate method of del Rio-Hortega; × 1,665.

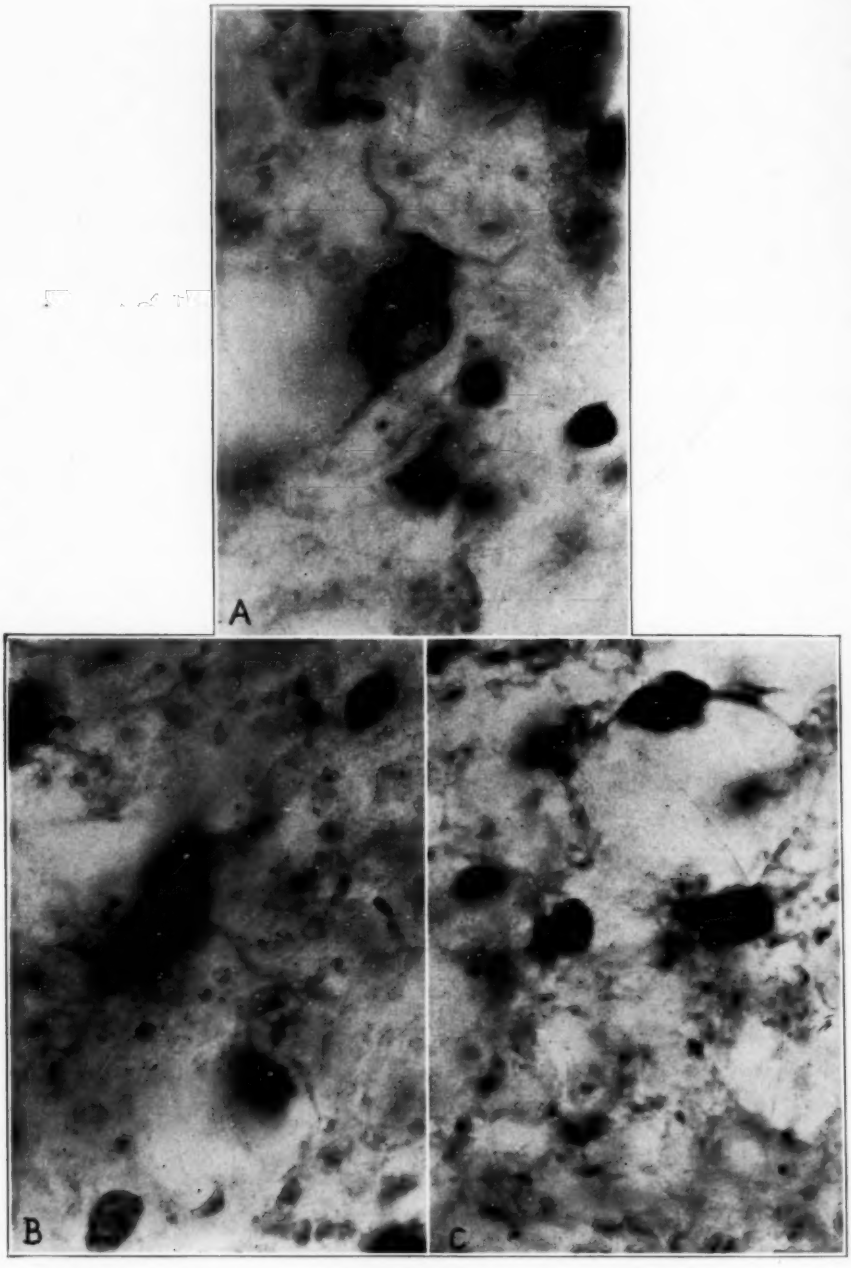

Fig. 12.—*A* and *B*, large oligogliocytes. *C*, a few oligogliocytes in the tumor. Silver carbonate method of del Rio-Hortega; × 1,665.

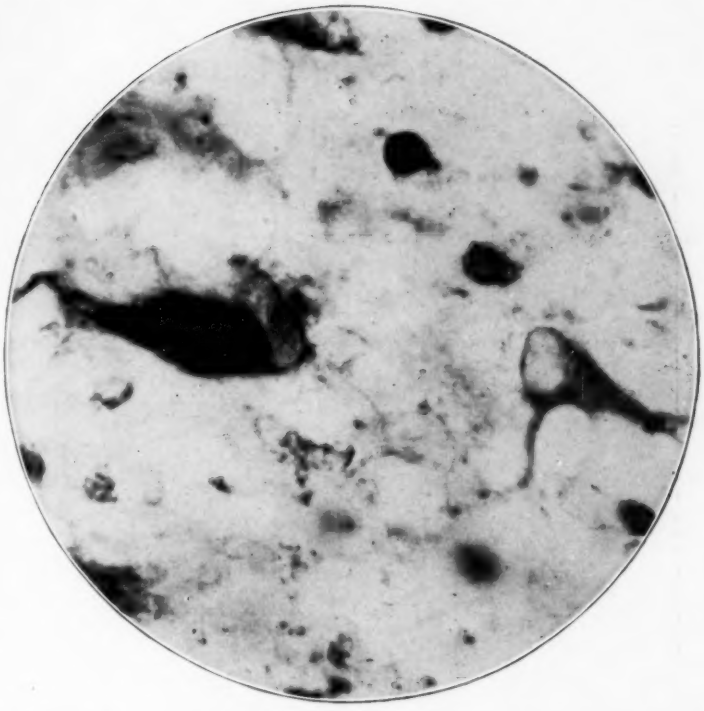

Fig. 13.—A large unipolar spongioblast and a large oligogliocyte developing from a spongioblast. Silver carbonate method of del Rio-Hortega; × 1,665.

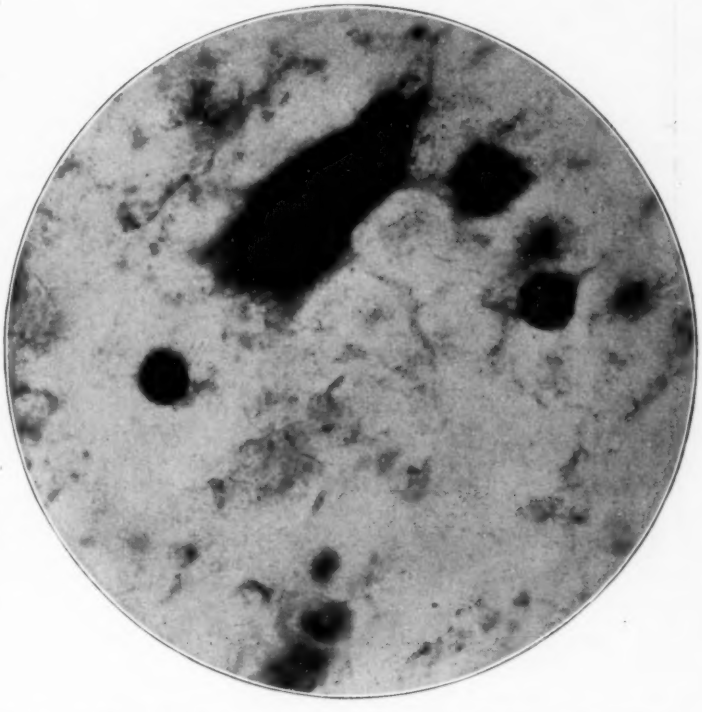

Fig. 14.—A transition cell with processes extending down to the vessel. Silver carbonate method of del Rio-Hortega; × 1,665.

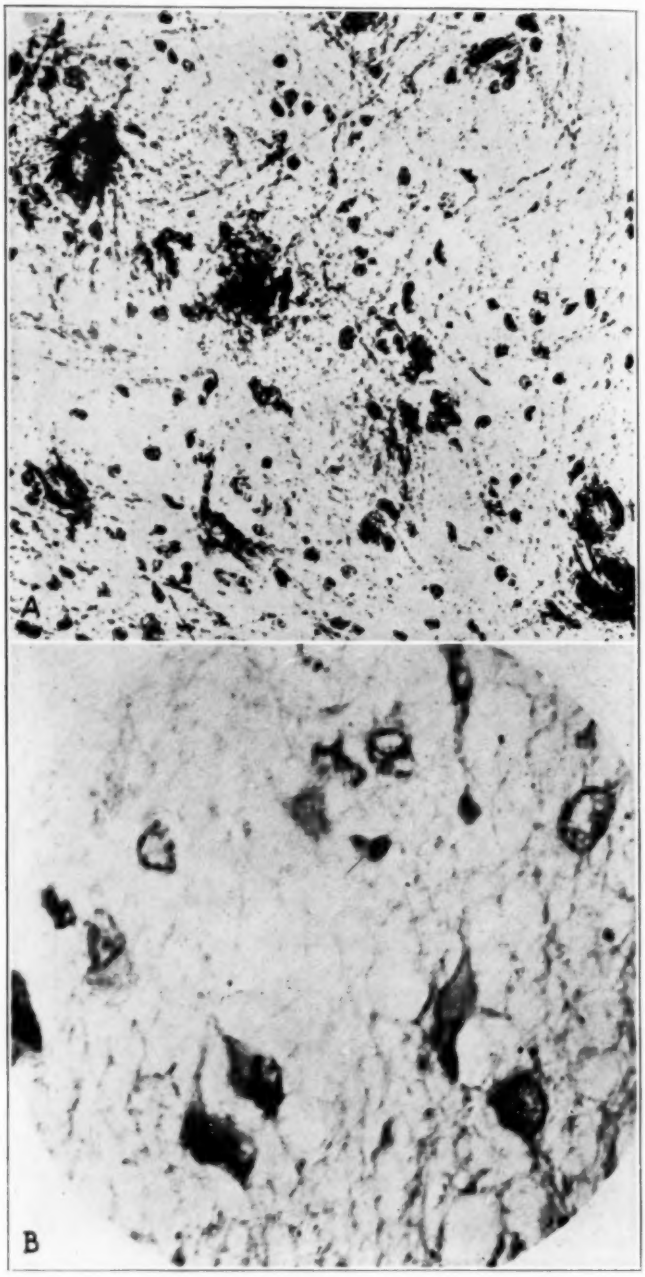

Fig. 15.—Astrocytes. *A*, a group of astrocytes in the capsule of the tumor. Silver carbonate stain; × 373. *B*, the same as *A*; hematoxylin and eosin stain; × 373.

was carried out on May 15. The x-ray pictures were unsatisfactory. As a result of this operative procedure, a rise in temperature and pulse rate was present for five days, with increased headache and increased swelling of the decompression.

The oil ventriculogram was repeated on May 28. This time, 5 cc. of oil was used to emulsify 15 cc. of cerebrospinal fluid for each ventricle. The ventricles were dimly outlined. The interpretation was that of a tumor situated either within the anterior horn of the right lateral ventricle or else encroaching on it to cause an obliteration of the latter. The oil in the ventricle again caused an increase in the intracranial pressure which necessitated tapping of the ventricles every day.

On June 4, Dr. Frazier reexplored through the original incision. A transcortical incision, 0.3 cm. deep, entered a cystic cavity from which 30 cc. of straw-

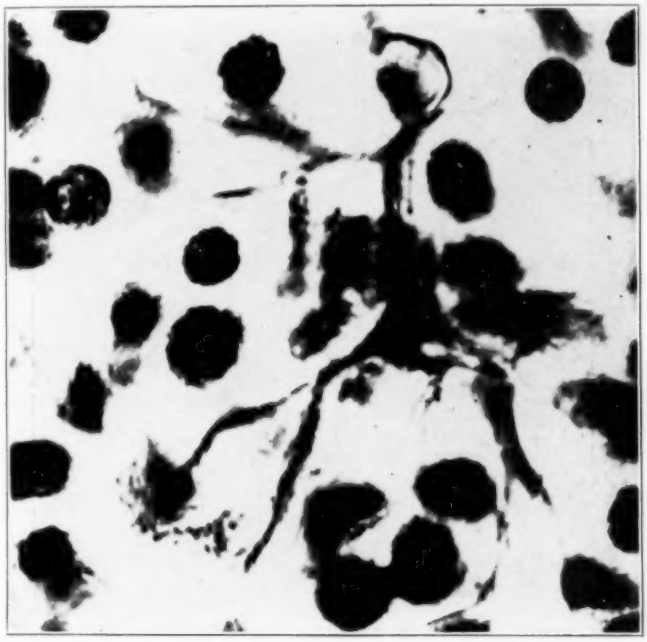

Fig. 16.—A large astrocyte in the oligodendroglioma. Silver carbonate method of del Rio-Hortega; × 1,665.

colored fluid was evacuated which solidified on standing. There was a smooth, bluish mass on the floor of the cyst, and this was thought to represent probably the remains of the glioma. As it was not deemed wise to attack the growth at this time, the bone flap was removed and the wound closed. Convalescence was uneventful. The only improvement noted at the time of discharge on June 22 was perhaps a lessening of the facial weakness on the left.

The patient returned for a course of roentgen treatment on Oct. 24, at which time there had been no change in the condition. In December, she was readmitted for observation and for tapping of the cystic collection in the right frontotemporal region. There was a complete paralysis of the left arm and a marked weakness of the left leg. Partial loss of sensation of the left half of the body remained the same as before. The optic nerve heads did not show choking. The patient had

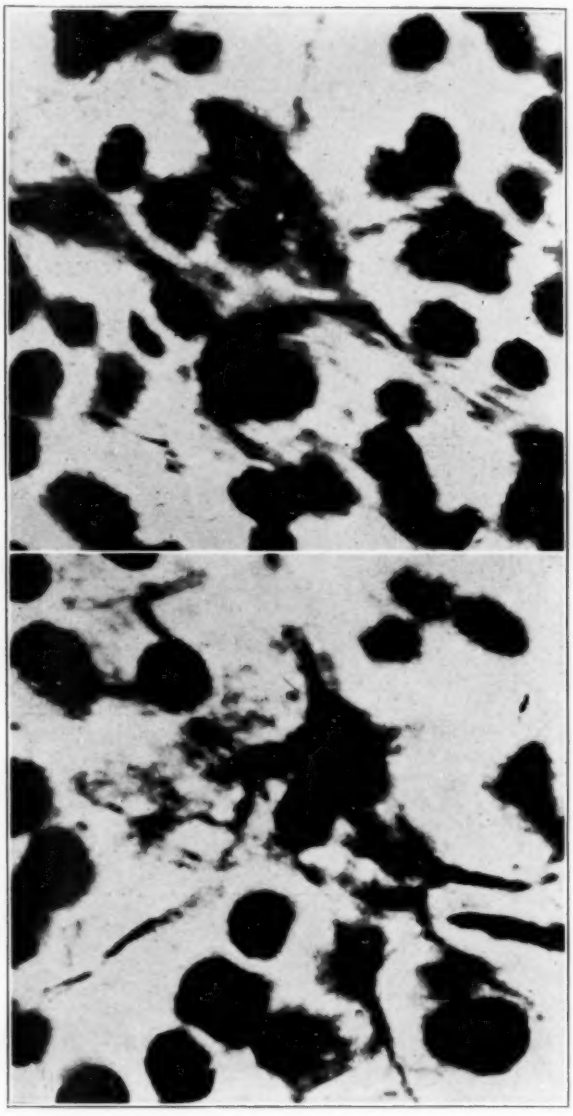

Fig. 17.—Giant astrocytes in the oligodendroglioma. Silver carbonate method of del Rio-Hortega; × 1,665.

headache whenever the cystic collection, which was believed to be the dilated right ventricle, refilled. At each tapping about 500 cc. of yellow fluid could be removed. The rate of accumulation was such that retapping became necessary about once in two weeks.

In this way the patient was carried along for the next nine months, when it was decided to attempt to retard the formation of the cerebrospinal fluid by the ligation of the right internal carotid artery. This was carried out on Sept. 5, 1929. The result was negative.

Final Admission.—Since the last discharge, the patient had been confined to bed, but there had been no increase in the symptoms. It was necessary to tap the

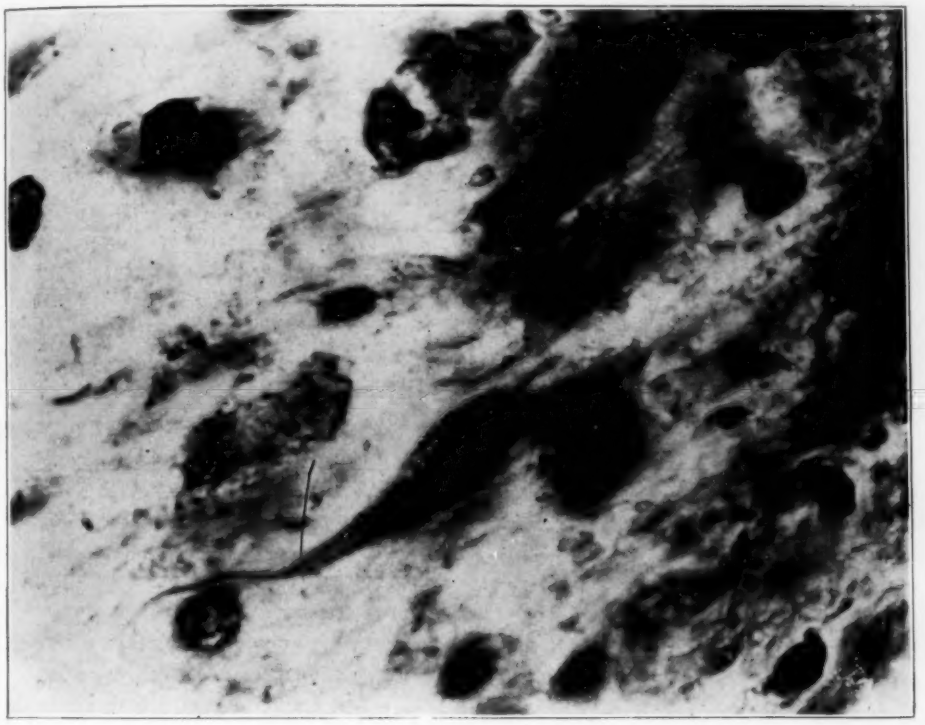

Fig. 18.—Bipolar spongioblast in the oligodendroglioma. Silver carbonate method of del Rio-Hortega; × 1,665.

ventricles every two or three weeks in order to relieve the recurrent headache and the associated vomiting. Vision had been good, and she was cheerful most of the time. Physically, she was in excellent condition. It was with the idea of establishing a communication between the two lateral ventricles that the third operation was proposed and carried out by Dr. Frazier.

On Jan. 21, 1930, with the help of a Bovie high frequency knife, the left ventricle was believed to have been entered after having traversed in succession many "cysts," large and small, in the right frontal lobe and after having perforated what appeared to be the septum pellucidum. Following the operation, the patient never recovered consciousness and died on the next day with marked hyperthermia.

Gross Description of Brain.—The brain was that of an adult female. There was an extensive distortion of the right cerebral hemisphere in the anterior half due to the fact that the dura over the site of the decompression was adherent to the scalp and muscle on the one hand and to the cortex on the other. So much laceration and traumatism incident to the removal of the brain had been added to the already existing operative wound and adhesions that the true and exact relationship of the tumor to the lateral surface of the right hemisphere could not be ascertained. However, the cortex of the right cerebral hemisphere showed marked atrophy. Over the superior and middle frontal lobe the cortex was hardly

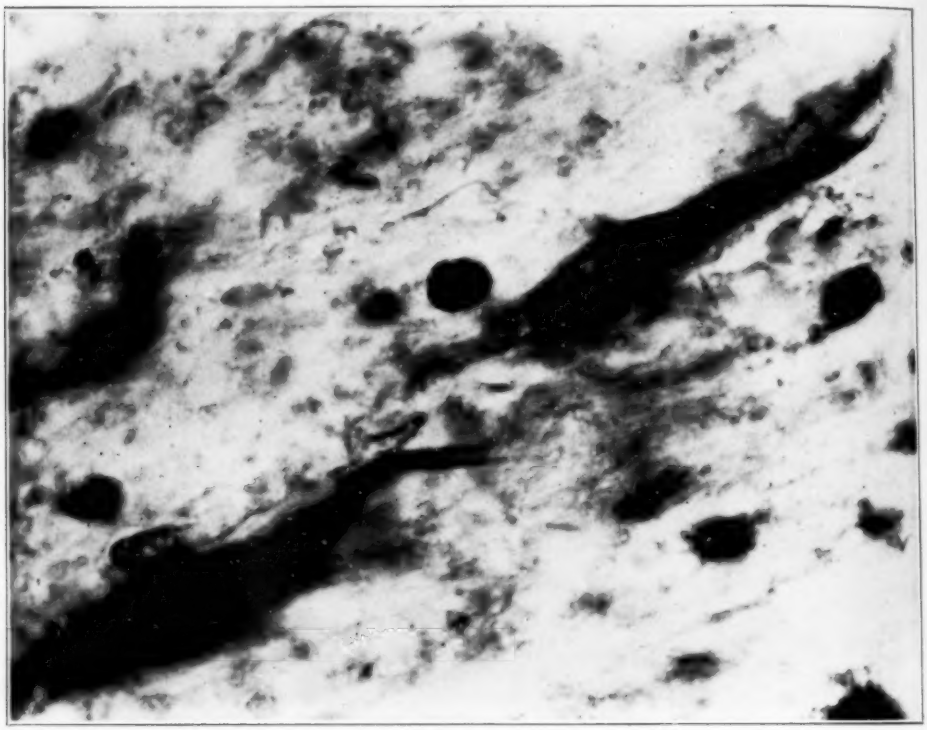

Fig. 19.—Spongioblasts in the oligodendroglioma. In the lower cell, forking of the processes can be observed. Silver carbonate method of del Rio-Hortega; × 1,665.

1 or 2 cm. thick, and in places there appeared to have been no cortex between the cavity of the ventricle and the thickened dura.

The right lateral ventricle was extremely dilated and probably was capable of holding at least 500 cc. of fluid when the patient was alive. Within this ventricle was a tumor that stretched from the anterior to the posterior horns.

The left lateral ventricle showed a moderate dilatation and contained a large blood clot that filled its posterior horn. There was free communication between the right and left lateral ventricles, there being no septum pellucidum recognizable. The third ventricle was broadened from side to side and its boundary distorted.

The right basal ganglia, which formed the right wall of the third ventricle, had been pushed to the right and toward the base of the brain, apparently by the advance of the tumor. On this account the corpus striatum and the thalamus, together with the internal capsule, were greatly compressed and pushed laterally. Further forward the caudate nucleus could not be identified. On following the

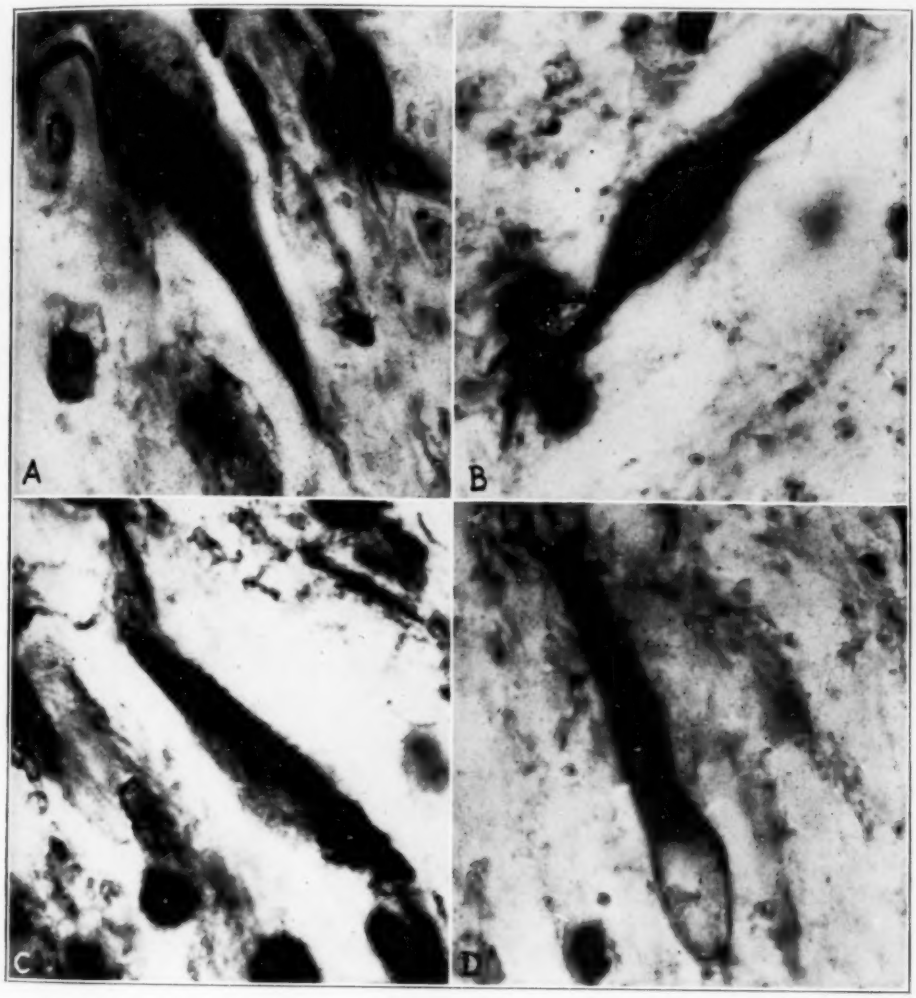

Fig. 20.—A group of spongioblasts in the oligodendroglioma. *A*, a unipolar spongioblast with a fork process. *B*, a bipolar spongioblast. *C*, a spongioblast with processes appearing at one pole. *D*, a spongioblast in the process of transition. Silver carbonate method of del Rio-Hortega; × 1,665.

ventricular system downward, it was found that the dilatation ended abruptly at the aqueduct. In all probability the posterior and inferior surface of the tumor must have come against the entrance of the aqueduct, producing dilatation of the ventricular system from that point forward.

Description of the Tumor.—The tumor was large, measuring 10 cm. in length, 7 cm. in width and 5 cm. in thickness, and not only lay within the right lateral ventricle, but occupied the third ventricle as well. It seemed to have taken origin from the mesial wall of the lateral ventricle, growing forward to reach the anterior horn and downward and backward into the third ventricle which it filled. Grossly, the tumor appeared to be covered by a layer of tissue that was continuous with the ependyma of the lateral ventricles. Dorsally, it came against the overlying corpus callosum, which was compressed but was not infiltrated by the tumor. This close relationship between the tumor and the corpus callosum existed from the genu to the splenium so that the tumor appeared to be hanging from the undersurface of the callosum. The surface of the tumor was smooth and unbroken, except in its lateral and inferior aspects, where it was macerated. Its consistency was soft. The cut surface revealed a granular appearance throughout, with the exception of a small part in the medial portion which was firm and smooth. The

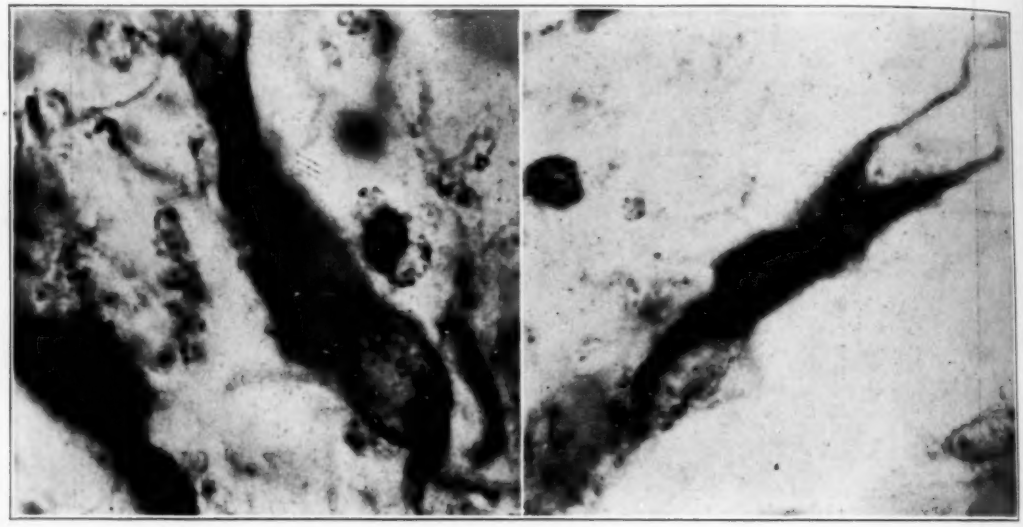

Fig. 21.—Transition forms between the spongioblast and the astrocyte. Silver carbonate method of del Rio-Hortega; × 1,665.

tumor was gray, except for the firmer portion which had the same color as the normal white matter. Small areas of cystic degeneration were found here and there. Very few blood vessels appeared within the structure of the tumor, and there was little matrix to hold the loose texture together.

Microscopic Description.—The tumor was extremely cellular and was made up chiefly of small cells closely packed together. They had a tendency to arrange themselves into rolls or cords. The entire tumor presented a strikingly uniform appearance with the rows on rows of cells densely packed together. As a whole, the growth was not particularly vascular, although occasionally dilated blood channels were encountered. In this particular tumor the blood vessels showed no undue proliferative changes.

Connective tissue stroma was not abundant. It was mainly associated with the blood vessels and spread out into the surrounding tissue, separating the tumor into lobules of varying size. This was particularly well seen with the van Gieson stain

or silver carbonate impregnations. No nerve fibers were found in the tumor. Glia fibrillae were extremely few. The "box-in" effect described by Bailey was well shown by the phosphotungstic acid-hematoxylin stain and was seen in areas of degeneration. At the junction of the tumor with the white matter of the brain a definite capsule was present. This was made chiefly of a dense network of glia fibrils in which lay astrocytes, some of which were normal and others of which were markedly hypertrophied.

The type of cell in the tumor was of great interest. As already stated, there was a marked uniformity in its appearance with the ordinary aniline dye stains, which gave it an almost characteristic appearance. These cells were often arranged in long rows or chains similar to the arrangement of the oligodendroglia in the

Fig. 22—Huge cell showing rather advanced transition between the spongioblast and the astrocyte. Silver carbonate method of del Rio-Hortega; × 1,665.

normal white substance of the brain. Often they were seen in small cords, and often no definite arrangement of these cells could be observed. The nucleus presented a decidedly uniform picture. It was round and possessed a well defined membrane, a good nucleolus and a rather scanty amount of chromatin material. The cytoplasm was extremely ill defined and appeared in the ordinary stains as an indistinct mass of pink-staining material rather indefinitely surrounding the nucleus. Only by special impregnation could the true nature of these cells be determined. Silver impregnation for oligodendroglia by the method of del Rio-Hortega revealed the fact that these cells were in reality oligodendroglia cells. By this method the cells showed the characteristic appearance of oligodendroglia, with their fine processes spreading out radially from a rather scanty cytoplasm

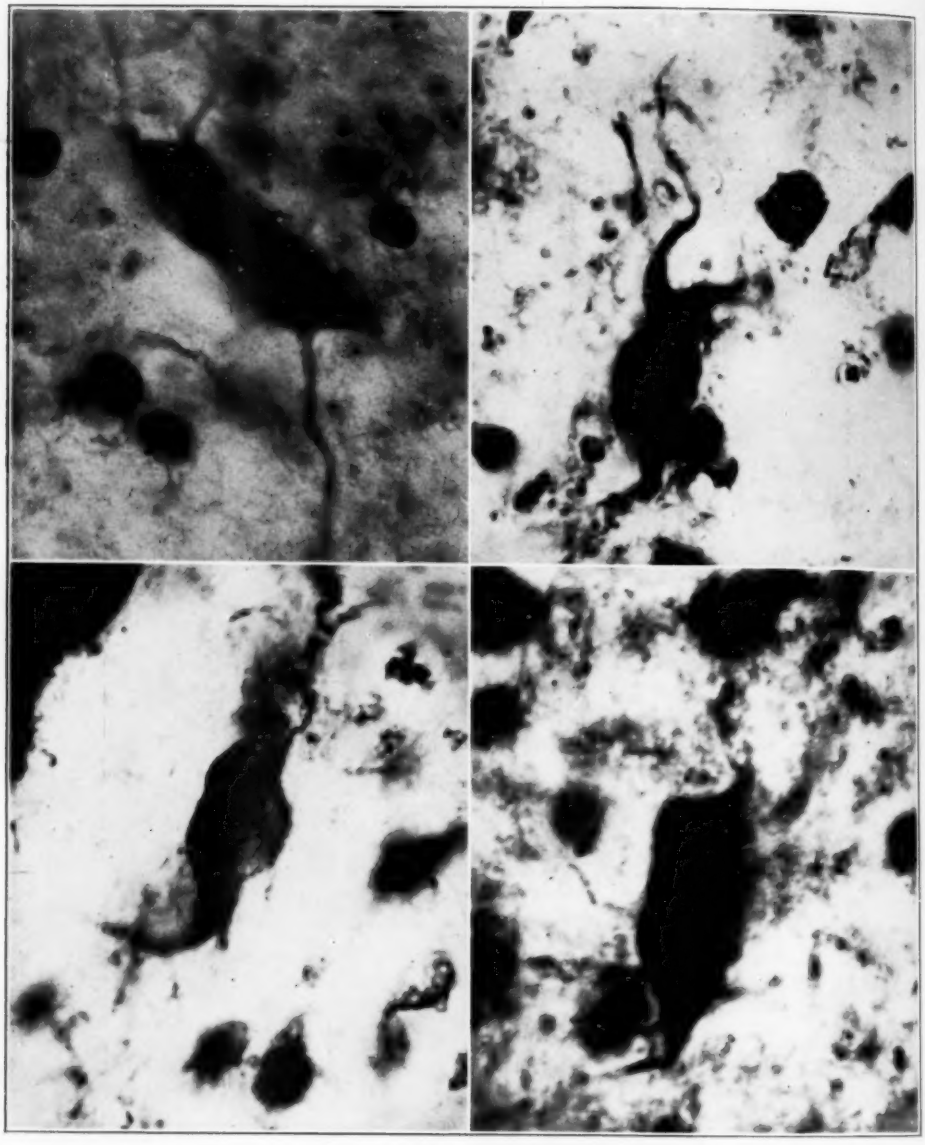

Fig. 23.—A group of transitional forms between oligodendrogliocytes and astrocytes. Silver carbonate method of del Rio-Hortega; × 1,665.

and extending in many instances for some distance. In some areas practically every cell could be impregnated and shown to be an oligodendroglia cell. Practically all of these corresponded to the small type of oligogliocyte which del Rio-Hortega has recently designated as the oligodendroglia cell of Robertson and which is found chiefly in the cortex and white matter under the cortex. The nodular swellings seen in the normal oligogliocyte could not be identified in most instances in the oligodendroglia cells that composed the tumor, nor could the gliosomes be found within the cytoplasm of the cells. Del Rio-Hortega's first variant, however, revealed a definite centrosome, with the typical halo around it. Among the small

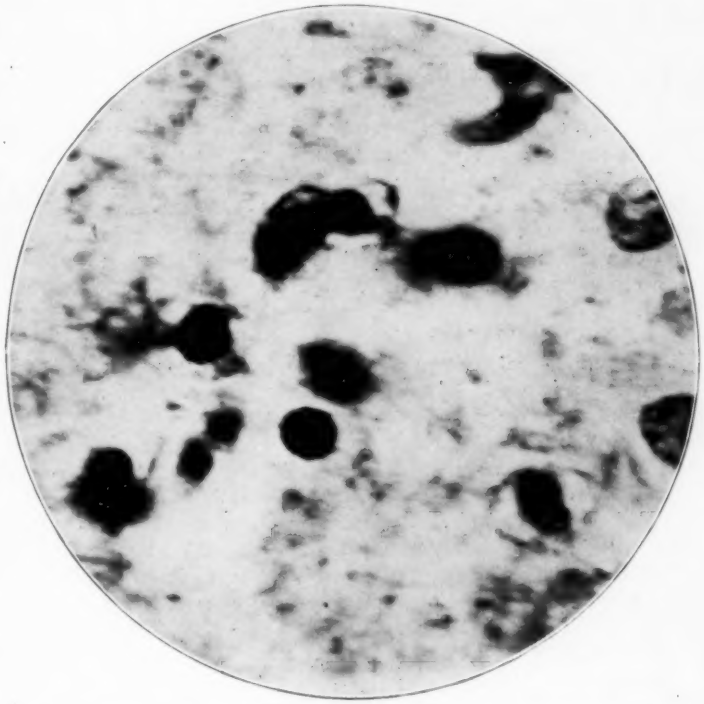

Fig. 24.—Acute swelling of the cells in the oligodendroglioma. Silver carbonate method of del Rio-Hortega; × 1,665.

oligogliocytes were larger cells that appeared very much like transition cells between oligodendroglia and astrocytes.

The latter were present in varying numbers in the tumor. They were most numerous at its periphery, both in and under the capsule. Some of them were normal in appearance, but many of them were much hypertrophied, with a swollen cytoplasm that had lost its normal angulations, and thickened processes that were sometimes tortuous. Within the tumor itself astrocytes could be identified, and they invariably appeared somewhat hypertrophied. On the whole, they were not very numerous in the tumor itself. In some parts of the capsule of the tumor, bipolar spongioblasts could be seen. They were never found within the tumor. Microglia were never found. In the vicinity of the tumor, the brain showed a

marked proliferation of fibrous astrocytes and reacted also by an acute swelling of the oligodendroglia.

CASE 2.—*Tumor of the left frontal region. Exposure and partial removal of tumor followed by recovery. Subsequent roentgen treatment. Death fourteen and one-half months after operation. Histologic diagnosis, oligodendroglioma.*

History.—A. W., a woman, aged 41, was transferred from the service of Dr. W. G. Spiller with the chief complaints of headache and convulsions. According to her story, she had been perfectly well up to three years before entrance when one morning she fell out of bed on the floor. Her daughter, who was sleeping in the same room, was awakened by the noise and found her mother on the floor, her arms and legs moving clonically and her eyes rolling, and she was frothing at the mouth. She was unconscious for about half an hour. On regaining consciousness, she had motor aphasia and could not make herself understood. She was certain that she had had no motor paralysis. After hospitalization for ten days, the aphasia disappeared completely. Soon afterward she had another attack of unconsciousness, ushered in by sudden dizziness. She vomited, and a generalized convulsion developed, with foaming at the mouth, rolling of the eyes and biting of the tongue. Following this she was unconscious for about half an hour. There was no paralysis or aphasia subsequent to this attack. A third attack occurred two or three months following this and was similar in all respects to the second one. From then on she had been having attacks of a similar nature about once every three months. These, however, had not been getting progressively worse.

In June, 1929, she had had sharp headache, described as a "pin-cushion," which started in the left occipital region and radiated to the left parietal and left frontal regions. These headaches had been increasing in frequency and severity until at the time of admission they were present continuously.

Coincident with the onset of headache, she had had attacks of dizziness which were more noticeable when she was up and walking around. She was practically free from dizziness when she was lying down. The eyesight had not failed, and she had not had any diplopia. Beginning in June, she had become irritable and preferred to be left alone. Appetite had been poor, but there was no nausea and she had vomited only once. The past history was of no importance, except that in 1925 a hysterectomy and oophorectomy were performed for the removal of uterine fibroids.

Physical Examination.—The temperature, pulse rate and respirations were normal. The blood pressure was 95 systolic and 65 diastolic. The chest, heart and abdomen were normal. A slight prominence of the left temporal region was noted.

Neurologic Examination.—The patient was clear mentally. Sensation was normal to all forms of tests. There was definite weakness of the right arm. The dynamometer registered 10 for the right and 22 for the left hand. The lower extremities did not show any difference in power. Diadokokinesia was normal. The finger-to-nose test showed hypermetria of the right hand. There was no past pointing. The reflexes were equal on the two sides and were within normal limits. Examination of the fundus of each eye revealed swelling of 4 diopters, with many hemorrhages and exudate, small and hardened arteries and engorged veins. The other cranial nerves were normal. Cerebrospinal fluid pressure measured in the horizontal position was 22 mm. of mercury (286 mm. of water). The fluid was slightly yellowish and contained 3 lymphocytes. The protein content was slightly increased. The serologic reaction was negative for syphilis.

Roentgen examination showed areas of necrosis of the fronto-temporal bones, and a thinning of the frontal bones on the left side. The dorsum sellae had practically disappeared, except for the posterior clinoid processes. Routine examinations of the blood and urine gave negative results.

Course.—On Aug. 18, 1927, while the patient was being observed, she had a generalized convulsion and lost consciousness. She had a series of convulsions during the four days following this attack. Although the convulsions were generalized at first, they gradually involved the right side more than the left. It was then decided to explore for a tumor of the left frontal lobe.

Operation.—On Aug. 27, after ventricular estimation had revealed a dilated right and an obliterated left ventricle, Dr. Grant turned down a large, left, fronto-temporal, osteoplastic flap and found a red, vascular, angry-looking tumor involving

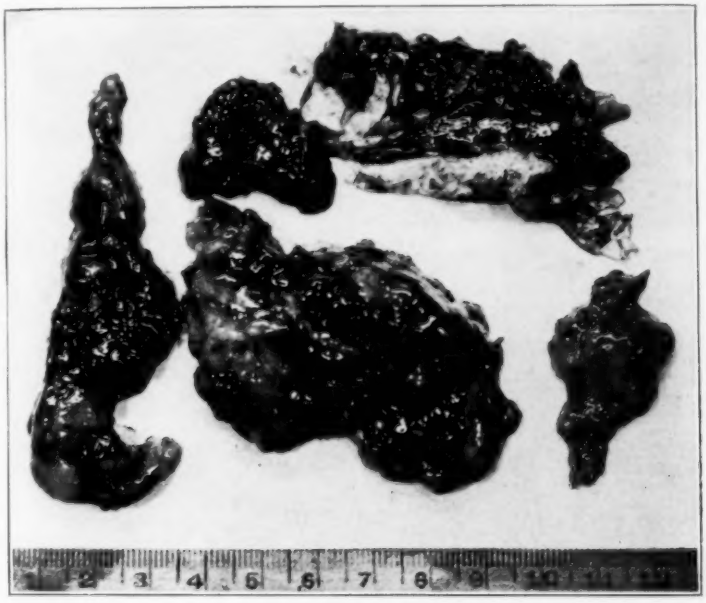

Fig. 25 (Case 2).—Fragments of the oligodendroglioma removed at operation.

the whole left frontal region above the fissure of Sylvius almost back to the fissure of Rolando. The tumor seemed discrete on the surface, but underneath it faded off indefinitely into the substance of the brain. As a frozen section made at the time of operation indicated that the growth resembled a sarcoma, it was decided to remove as much of the tumor as possible and at the same time to provide an adequate decompression over the tumor by removing the bone flap. When these steps had been accomplished, the wound was carefully closed, the dura being left unsutured.

Subsequent History.—A postoperative right hemiplegia, together with motor and sensory aphasia, developed promptly. However, in about ten days the patient slowly regained speech and motor power in the right leg. By the end of two weeks, she was able to grasp objects with the right hand. A month from the time of operation, there was nothing to indicate an aphasia. She carried out

commands perfectly and could read fluently. The gait was slightly hemiplegic. There was a slight weakness of the right side of the face, arm and leg, but no sensory disturbance. The reflexes were equal, and there was no Babinski sign or clonus. The operative wound had healed and there was a moderate bulging of the decompression. The swelling of the optic disks had diminished from 4 diopters to about 1 diopter. The retinal hemorrhages and exudates had already been absorbed. No convulsions had occurred since the operation. She was discharged on October 30.

Roentgen Treatment.—Before discharge, she was given a course of deep roentgen treatment. She returned on November 21 for a second course of roentgen

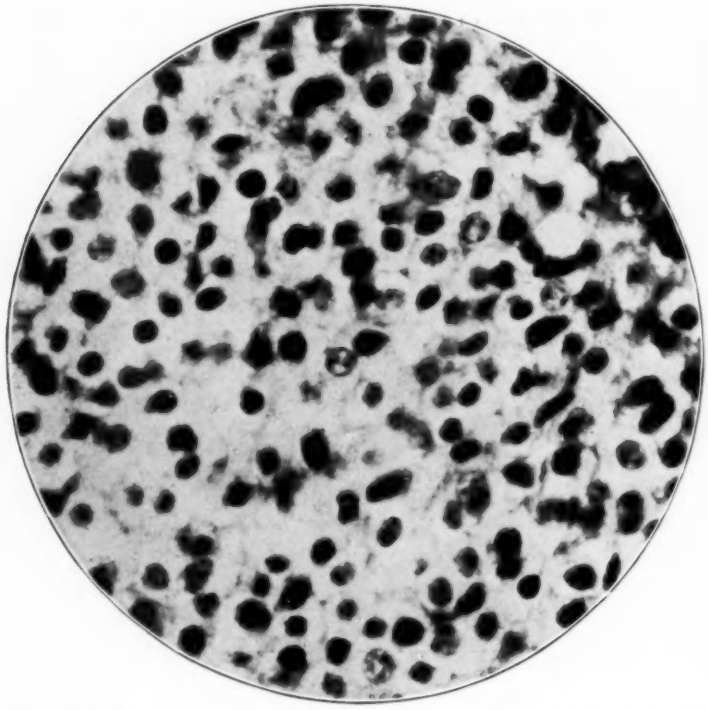

Fig. 26.—High power view to show the general architecture of the oligodendroglioma. Hematoxylin and eosin stain; × 920.

therapy. She had not had an attack of convulsions, but in October she had had a minor attack in which she "felt queer," and it caused her to remain in bed for one day. She had had no difficulty in understanding speech and commands. In fact, she had improved in every way. Following completion of the roentgen treatment, she was sent home on December 16.

She was again seen in February, and in June, 1928. On each occasion it was found that she had maintained the improvement. Roentgen treatments were continued.

She again entered the hospital on October 8 for more roentgen treatment. On October 11, she had two attacks of motor aphasia, the first lasting ten minutes

and the second fifteen minutes. On the next day she felt rather weak and showed evidence of having had a convulsion during the night. The roentgen treatment seemed to have produced an unfavorable reaction. She went into status epilepticus and soon bronchopneumonia developed, from which she died on November 7, a year and two months after the operation.

Examination of the Brain.—Examination through the operative wound was permitted. The scalp over the bone defect was depressed. The brain was very small. The posterior half of the old incision was opened and the brain exposed. The convolutions of the posterior part were widened and flattened and almost completely avascular. The brain was putty-like in color and slightly yellow. At

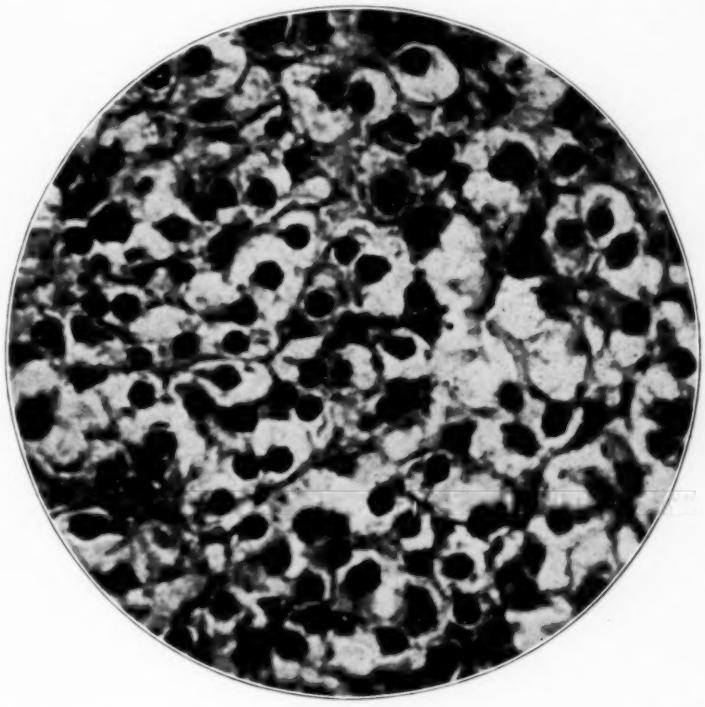

Fig. 27.—Honeycombing effect in the tumor. Phosphotungstic acid-hematoxylin; × 920.

the anterior edge of the exposure, and next to what appeared to be a tumor, there was a convolution that was wider, firmer and more pale than the rest of the brain. It appeared as though the tumor had infiltrated this convolution. What appeared to be tumor tissue was found in the region of the sylvian fissure.

Microscopic Description.—As in the preceding case, the striking feature of the tumor lay in its monotonous uniformity with the usual routine stains. It was an extremely cellular tumor, with closely packed nuclei and cell bodies, all of which appeared much alike. Often the cells were arranged in rows or cords, much like the arrangement of the oligodendroglia cells in the white matter of the brain. Usually, however, there was no distinct architectural arrangement except that the cells were packed closely together. Blood vessels were numerous in the tumor

and were often filled with blood. Hemorrhages, both large and small, were present in the tumor. There was little connective tissue stroma. Coarse strands of tissue could be seen in silver preparations scattered in small islands throughout the tumor. These rarely penetrated very deeply into the tumor substance, and

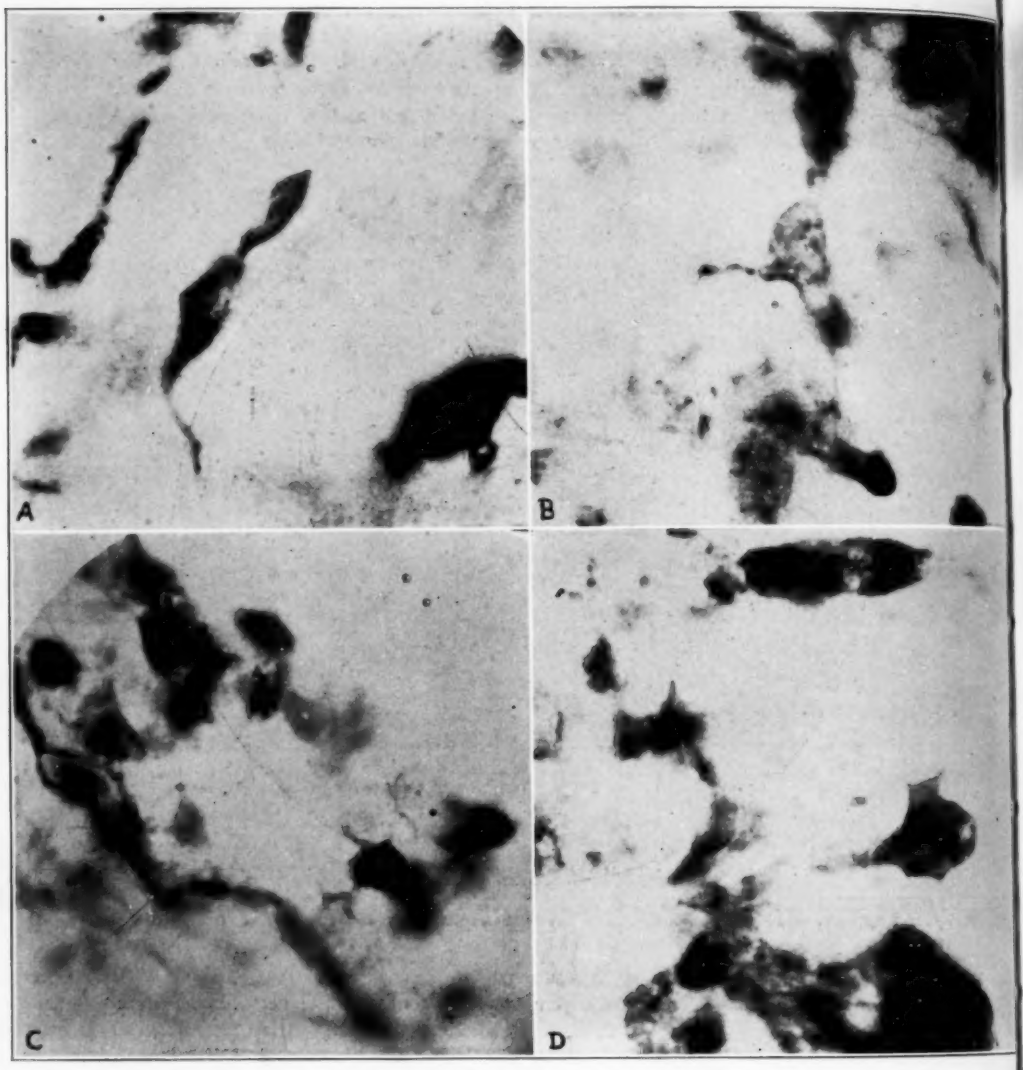

Fig. 28.—*A*, spongioblast in the oligodendroglioma. *B*, *C* and *D*, oligodendrogliocytes composing the tumor. Silver carbonate method of del Rio-Hortega; × 1,665.

were derived from the adventitia of the blood vessels. Areas of degeneration could be made out here and there. In these regions the "box-in" effect of which Bailey and Bucy spoke could easily be made out. However, in the regions in which the

tumor was well preserved this arrangement could not be discerned. With the aniline blue stain of Mallory, the cells could be seen surrounded as if in a honeycomb arrangement by a deep blue membrane. Often two or three cells could be seen surrounded by such a membrane. Usually, the cells did not fill the little compartment made by these membranes, but lay retracted from their edges.

By the phosphotungstic acid-hematoxylin method, astrocytes could be made out within the tumor. These were not as numerous as those described in case 1, but they were scattered through the tumor in goodly numbers, usually situated in the vicinity of vessels. Like those described in case 1, they were hypertrophic types, with an increased amount of cytoplasm and thickened processes.

Neuroglia fibrillae were not seen in the tumor, except in scattered numbers here and there. The phosphotungstic acid stain revealed no fibrillar carpet or network. The intercellular substance had a rather flimsy appearance.

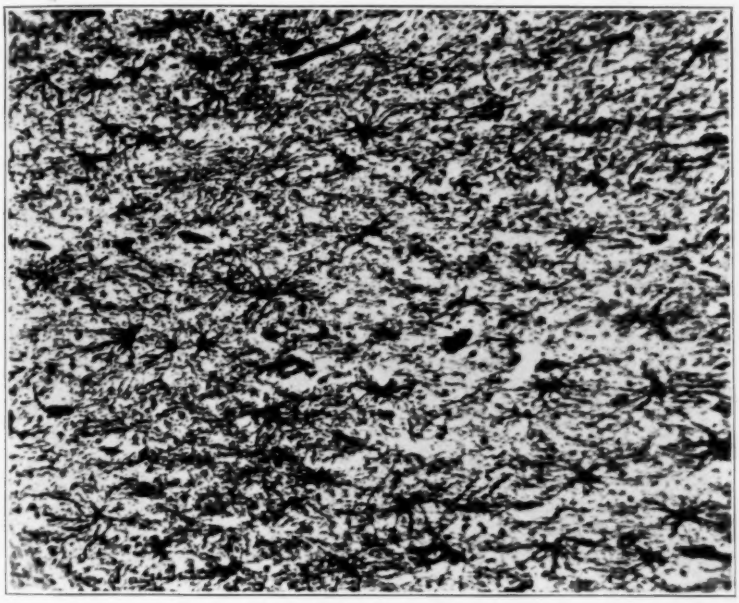

Fig. 29.—Gliosis. There is an increase in the number of fibrillary astrocytes in the brain near the tumor. Gold sublimate method; × 218.

The type of cell in this tumor was identified by means of del Rio-Hortega's silver carbonate method as the oligodendroglia cell. Not all the cells could be impregnated successfully, because of the extreme density of the tumor. However, representative areas of the tumor when impregnated with silver showed typical oligogliocytes. These had the typical round nucleus with scanty cytoplasm, and fine, slender processes spreading out in various directions. As in the previous case, no gliosomes could be identified in the oligogliocytes composing these tumors, and the nodular swellings that characterize these cells in the white matter were not seen. The type of oligogliocyte corresponded to the small type of cell which del Rio-Hortega called the type of Robertson, and which is found in the white matter of the cerebrum and around the nerve cells. An unusually large number of the oligogliocytes were found which represented what appeared to be transition forms between oligogliocytes and astrocytes. These had a more abundant

cytoplasm and larger, broader processes, but did not have the angular appearance of the astrocyte. Neither did they possess the glia fibrils within their substance. These larger cells tended to be more numerous near the vessels, although they were by no means confined to these areas. By the first variant of del Rio-Hortega, typical centrosomes could be seen in the tumor cells, but no neuroglia fibrillae could be demonstrated.

An extremely interesting feature of this tumor was the discovery of a thick infiltration of the subarachnoid space in the sylvian fissure by tumor cells which by the usual stains appeared much like the cells of the tumor already described. With specific impregnations these cells could be seen very faintly to possess cytoplasmic processes similar to those of oligogliocytes, but the impregnations were more suggestive than conclusive. No astrocytes could be demonstrated among these cells, though they were impregnated very well in a piece of attached cortex. We presumed that the cells seen in the subarachnoid space were oligogliocytes from the oligodendroglioma situated in the brain.

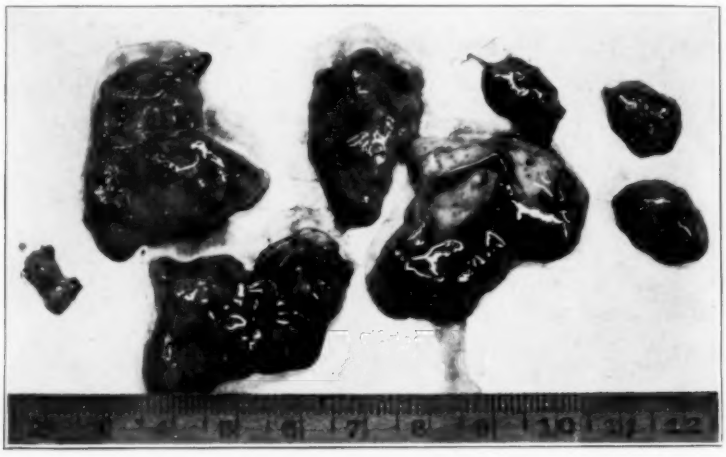

Fig. 30 (case 3).—Fragments of the oligodendroglioma removed at operation.

CASE 3.—*A tumor of the right parietal lobe with a history of headache, vomiting, diplopia and dizziness of nine months' duration. Failure to expose tumor at operation. Subtemporal decompression followed by temporary improvement. Development of jacksonian convulsions. Reexploration of the old wound two years after the first operation. Discovery and removal of tumor. Patient in good condition two years after operation. Death five years after operation. Tumor identified as oligodendroglioma.*

History.—J. G., a man, aged 41, was transferred to the neurosurgical service from the service of Dr. W. G. Spiller on June 19, 1925. His complaints were headache, vomiting and double vision. He had been perfectly well until September, 1924, nine months before he sought surgical relief. At this time he noticed that he had slight occipital headache, vertigo and double vision on changing position. These conditions remained unchanged until March, 1925, three months before admission, when he began to have severe headache in the occipitoparietal region, associated with projectile vomiting and diplopia. He also had ataxia and loss of coordination of the left arm and leg. From then on until the time of

admission these symptoms remained about the same except that the headache and vomiting were not quite so severe.

There was no history of convulsions, unconsciousness, paralysis or defect in speech or hearing. No history of injury to the head or suppurative diseases of the ear and sinuses was obtained. It was recorded in the past history that the patient had had pneumonia at the age of 6, typhoid at 16, a syphilitic sore at 20 and gonorrhea at 20 and again at 25.

Physical examination.—The patient was well developed, well nourished and apparently in perfect control of his faculties. Physical examination gave essentially negative results.

Neurologic examination.—Gait was normal. There were slight swaying in the Romberg position and unsteadiness in standing on the left leg. In the finger-to-nose test, the left hand wavered, but the right was steady. The left foot

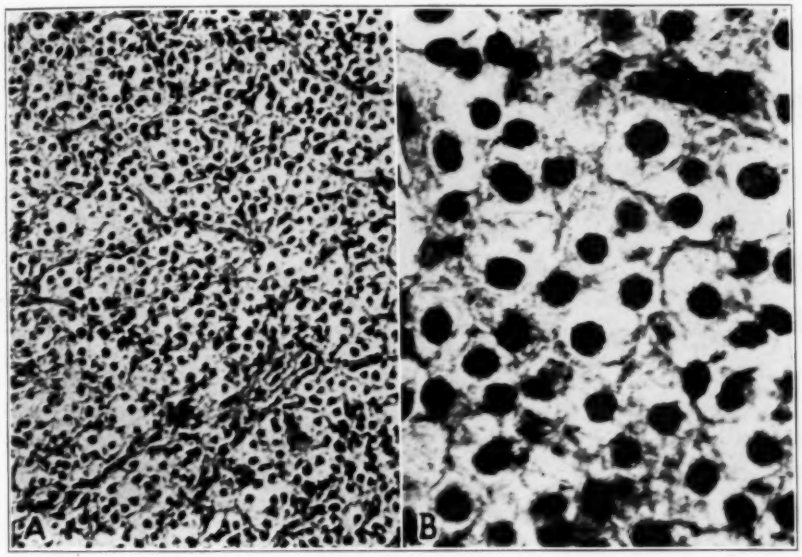

Fig. 31.—*A*, general arrangement of the tumor. Hematoxylin and eosin; × 218. *B*, high power view of the tumor, showing the honeycomb effect. Hematoxylin and eosin; × 920.

was unsteady in the heel-to-knee test. There was no definite past pointing, and diadokokinesia was normal. There was a subjective feeling of numbness of the right third and fourth fingers and of the arm and the right side. All forms of sensation were impaired on the left side of the body except the face. The sense of position was greatly impaired in the toes and hand on the left. The sense of vibration on the left was also very markedly diminished. Stereognosis was definitely impaired in the left hand. There was no paresis and no decided weakness of either side of the body, although subjectively the patient felt the left side of the body to be the weaker. The cranial nerves were essentially normal except for a slight paresis of the right internal rectus. The pupils were unequal, the right measuring 5 mm. and the left 5.5 mm. in the horizontal diameter. There was no nystagmus. There was bilateral choking in the early stages, with swelling

of about 1 diopter in the right eye, and 1.5 diopters in the left. A few scattered hemorrhages were seen about the swelling but no well marked exudate. The visual fields revealed a left inferior quadrantanopia with a tendency to a hemianopia in the left eye. Roentgen examination of the head gave negative results. The pituitary region, however, showed definite abnormality. The dorsum sellae was much atrophied, and the posterior clinoid processes had disappeared. The pituitary fossa was 14 mm. in the anteroposterior diameter and about 10 mm. in depth. No calcification was seen.

The reflexes of the left side were slightly exaggerated. There was an atypical Babinski sign and a pseudoankle clonus on the left. Lumbar puncture was performed on June 20, and a pressure of 14 mm. of mercury (182 mm. of water), with the patient in the horizontal position, was registered. The fluid was clear and contained 3.5 lymphocytes per cubic millimeter. A diagnosis of tumor of the right parietal lobe was made and exploration advised.

Operation.—On June 24, 1925, Dr. Frazier performed an exploratory craniotomy. The cortex was not abnormal save for somewhat flattened convolutions. The subcortical tissue seemed less resistant than normal tissue to the passage of a cannula, and it was thought that an extensive subcortical glioma was probably present. After a subtemporal decompression had been provided, the wound was closed.

Postoperative Course.—Jacksonian convulsions developed on the second day after the operation, starting in the left side of the face, spreading to the left arm and leg, and then becoming generalized, with loss of consciousness. The left side of the body became paralyzed. Under sedatives the convulsions did not return. The patient improved, and on July 1 was able to be up in a chair.

He was given roentgen therapy without special benefit. He was discharged on July 19 and was relieved of a great many of the symptoms. The choked disk had subsided, but there was still impairment of sense of pain and position in the left upper extremity, and stereognosis was moderately impaired bilaterally.

Subsequent Admission.—The patient returned on September 13 for observation and further roentgen treatment. It was learned that twelve days after discharge he had had a jacksonian convulsion during which the left upper and lower extremities were involved, with loss of consciousness and biting of the tongue. A similar attack had occurred in the first part of September. During this convulsion, it was observed by the family physician that the decompression became considerably larger and more tense. Apart from these two convulsive seizures there had been no other symptoms. Speech was slow but not defective, and memory remained unimpaired. The left biceps, triceps, patellar and achilles reflexes were increased. There was decided loss of sense of position in the left hand and foot. Tactile discrimination was greatly impaired over the left side. Astereognosis was marked in the left hand. Subjective pain in the left leg was present with the feeling as though the heel had been pressed between the finger and thumb. He was given two series of roentgen treatments over the head from which he appeared to have no ill effect and was discharged on September 26.

He returned on December 1 for more roentgen treatment in very much the same condition as on discharge. Convulsions appeared on December 6 and were preceded by an aura in the form of a peculiar sensation in the left hand and a prickling sensation in the left side of the upper lip. The left arm and leg then began to twitch, and he went into a generalized seizure accompanied by loss of consciousness. Neurologic examination on this admission failed to reveal anything that had not been recorded before. The outstanding observations were a slight left-sided weakness and a slightly larger left pupil. In his speech he occasionally

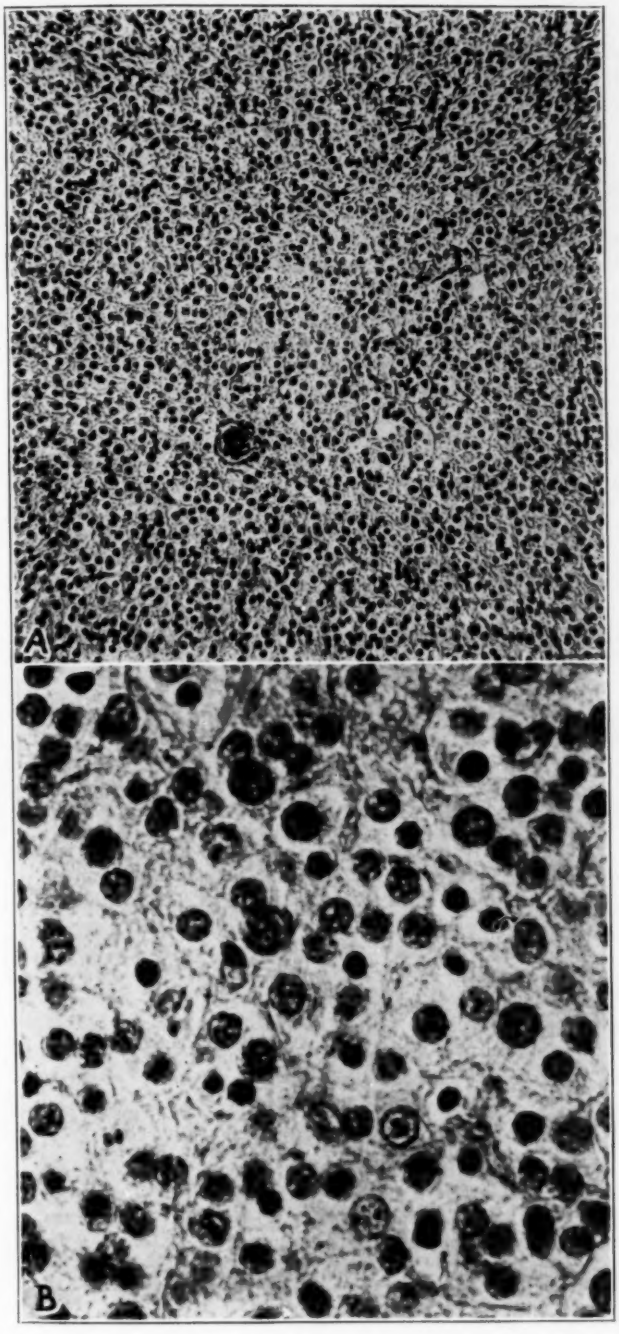

Fig. 32.—*A*, low power view to show the general architecture of the tumor. Hematoxylin and eosin; × 218. *B*, high power view of the tumor, showing the honeycomb effect. Hematoxylin and eosin; × 920.

stumbled over syllables, but could correct the mistake immediately. He could say the usual test phrases without difficulty. His vision was good, and there was no choking of the disks.

Fourth Admission.—The patient returned on May 27, 1927, with the story that besides the convulsions, which had appeared periodically, there had been a return of headaches which were severe and located in the occipital region. After the convulsive attacks he experienced difficulty in using the left hand. He would drop objects from the hand and would have trouble in picking up and arranging things. Examination at this time showed a slight impairment of memory. He staggered, usually to the left, in the heel and toe test. There was some past pointing and adiadokokinesis in the left hand. Horizontal nystagmus on lateral gaze was present. There was hyperesthesia in the left upper extremity, with weakness of both the arm and the leg on the same side, and with astereognosis and loss of sense of position in the left extremities. The reflexes on the left side were slightly exaggerated. A left homonymous hemianopia was found in the visual fields.

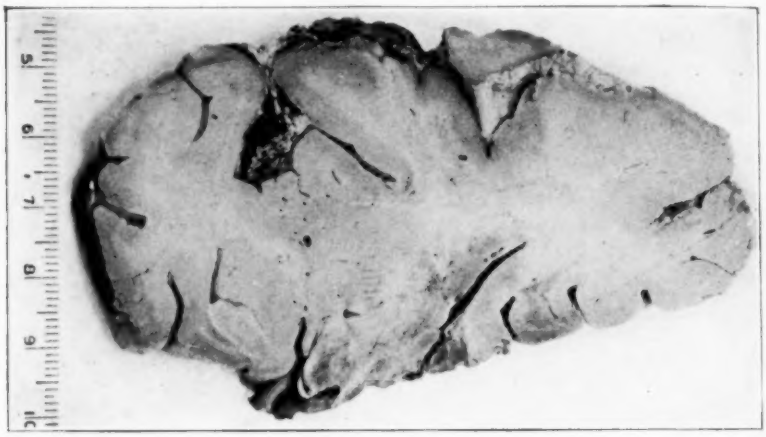

Fig. 33 (case 2).—Infiltration of the subarachnoid space in the sylvian fissure by tumor cells.

Operation.—On June 11, Dr. Frazier reopened the old incision. Bleeding from adventitious vessels was very free, and considerable difficulty was encountered in controlling it. When the dura was reflected, the cortex appeared pale, but no tumor was seen on the surface. A transcortical incision was made parallel to the postcentral convolution and behind it, and at a depth of 3 cm. below the surface a well encapsulated, reddish tumor was seen. By the introduction of four retractors the growth was removed in its entirety. The bone flap was removed to allow for decompression. As was expected, a complete left hemiplegia developed from which the patient slowly recovered. At the time of discharge, on July 18, with the exception of the weakness in the arm and leg, there was good motion in the left arm and leg.

The patient returned for further observation on March 27, 1928. While physically in good health, he had pain in the back of the neck and over the center of the operative scar. Occasionally, there was numbness and tingling in the left arm and leg. The left hemiparesis had remained unchanged since the last operation.

Weakness of the extremities of the left side persisted. The left homonymous hemianopia was not more definite. The deep reflexes on the left were exaggerated, with an abortive ankle clonus and a Babinski sign on the left. While in the ward he fell and substained a fracture of the left femur. For this condition a cast was supplied which he still wore at the time of discharge. Following discharge he became mentally deteriorated and died in April, 1930, having lived for five years after the operation.

Microscopic Description.—The tumor had a remarkably uniform appearance. The cells were all similar in appearance and were sometimes arranged in rows. The nuclei were round and well defined and possessed a good nucleolus and a few

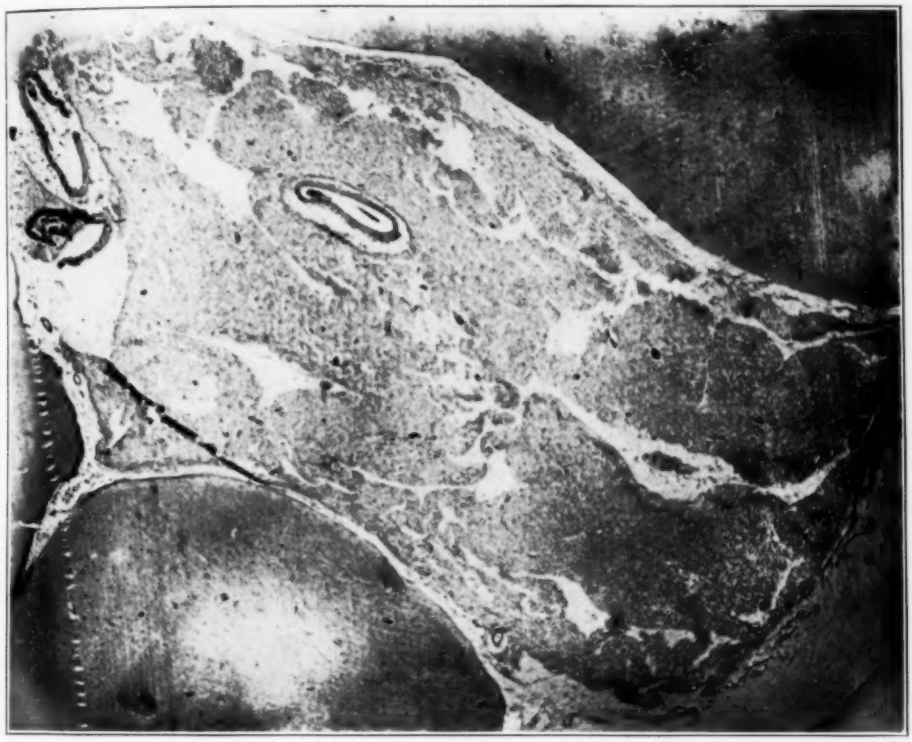

Fig. 34.—Infiltration of the subarachnoid space by tumor cells.

heavy clumps of chromatin. The cytoplasm was extremely ill defined and appeared like a small flimsy mass around the cell. No mitoses were seen. The tumor was vascular and had small areas of hemorrhage within it. Fibroblasts were numerous in areas where degeneration was present, and here the honeycombing effect could also be seen.

CASE 4.—*Tumor of the left frontal lobe with a history of headache, weakness, loss of vision and beginning mental degeneration of about six months' duration. Transfrontal craniotomy with evacuation of gliomatous cyst. Subsequent treatment with x-rays without effect. Second operation two years later. Death followed the operation.*

History.—R. B., a woman, aged 43, was admitted to the neurosurgical service on July 2, 1925, complaining of weakness and loss of vision. She had been well up to the latter part of December, 1924, when she began to have severe frontotemporal headaches. In January, 1925, she noticed rapid loss of vision, but headache was still her main trouble at this time. She entered the Jefferson Hospital on January 8, and remained there until February 14. There she was found to have choked disks, with fresh hemorrhages in the retinas. Lumbar puncture showed a pressure of 25 mm. of mercury. Decompression for tumor of the brain was advised, but the patient left the hospital on February 14, only to return on March 24. A decompression was done on the next day. Recovery was uneventful, and she was discharged on April 30.

While the headache was relieved by the operation, the eyesight had not improved. On the contrary, it had become a little worse. She had not had any convulsions, but she had had transient attacks of unconsciousness. Since then she had become worse in every respect. Speech became aphasic, and memory was deteriorating. In the last few weeks, she had become very weak and seemed unable to move around. At times she could not swallow solid food, but could take liquids. There was never any history of dizziness.

Physical Examination.—The patient was well built but slightly undernourished. She appeared neither acutely ill nor in great pain. Her conversation was silly at times, and she was uncooperative and untidy. Gait was slightly ataxic and uncertain, owing partly to poor vision; station, however, was normal. There was a large hernia cerebri in the right temporal region. The ears, nose, throat, heart and lungs were normal. A scar in the lower part of the abdomen was the result of a pelvic operation ten years previously. The extremities were normal. All forms of cutaneous sensation and deep sensibility were unimpaired. There was no astereognosis, adiadokokinesis, dysmetria or ataxia.

Examination of the cranial nerves revealed bilateral loss of the sense of smell. Vision was markedly reduced. Slight lateral nystagmoid movements were constantly present. There was 4 diopters of choking in each eye, with several areas of small hemorrhages in the retinas. The pupils were dilated and equal and reacted well. There was no weakness of the muscles of mastication, nor was there any facial weakness. The movements of the soft palate and uvula were normal, and sensation in the throat was unimpaired. The tongue protruded in the midline and showed no tremor. The reflexes in the upper and lower extremities were bilaterally exaggerated. There were bilateral abortive clonus and bilateral Babinski and Oppenheim signs.

Roentgen study of the head revealed an absence of the dorsum sellae and clinoid processes with a rather typical disk-shaped sella, indicating an extrasellar tumor. The routine laboratory tests of the blood and urine gave negative results, except for a mild degree of secondary anemia. The preoperative diagnosis was either a tumor of the frontal lobe or a tumor of the pituitary gland, with strong leaning toward the former. A ventricular estimation clinched the diagnosis of tumor of the left frontal lobe.

Operation.—On July 14, 1925, with the patient under local anesthesia, Dr. Grant performed a left transfrontal craniotomy. No tumor was seen in the cortex or around the region of the pituitary gland. Although the brain did not feel cystic to palpation, a cannula was introduced into the frontal lobe and there entered a gliomatous cyst at a depth of about 3.5 cm. Twenty cubic centimeters of yellow, gelatinous fluid was removed, and this soon coagulated on standing. A transcortical incision was made, and the tumor was reached. It had no line of

cleavage. A piece of this growth was removed for diagnosis. Hemostasis having been secured, the wound was closed after a decompression at the base of the flap had been provided.

Subsequent Course.—The immediate recovery of the patient from the operation was uneventful. Two and a half weeks afterward, lobar pneumonia of the right lung developed from which she slowly recovered. She was given a course of roentgen treatment. At the time of discharge, on August 8, vision had improved and choking of the disk was relieved. She was free from headache and vomiting. Other conditions were the same as on admission.

Second Admission.—The patient returned for observation in November. She was then having headache, aphasia, diminished vision and mental confusion. On November 12, she suddenly became stuporous, with a respiratory rate of 12 per minute. The left frontal lobe was tapped through a trephine opening, and after 30 cc. of bright yellow fluid had been removed from the cyst the patient promptly regained consciousness. She was sent home to await further roentgen treatment. This she received in December, 1925, in March, 1926, and again in July, 1926. There was some improvement in mentality, but she continued to have headache, although the choked disk had completely subsided. She had attacks of unconsciousness, and there was some weakness in the right hand. Increase of deep reflexes on the right side was noted.

Believing that it was advisable to retap the cyst, Dr. Grant, on June 7, 1927, attempted to enter the cyst along the direction previously taken. Instead of entering the cyst, he encountered the ventricle. The assumption was that the x-rays had destroyed the cyst.

Final Admission.—On June 23, the patient was again taken to the hospital. She had been growing progressively worse, with increased mental deterioration. At times she was incontinent. A ventriculogram was taken on July 11, the air being injected into the left anterior horn. The x-ray films revealed a lesion obliterating the posterior and inferior horns of the left lateral ventricle.

Second Operation.—Under ether anesthesia, the old bone flap was reopened by Dr. Grant without any particular difficulty. A large tumor was found extending into the left temporal lobe and in the lower part of the left frontal lobe, involving the entire floor of the lateral ventricle. There was a smooth cyst wall anteriorly which communicated with the ventricle and which must have been the original cyst of the tumor. A piece of the growth was removed for verification. There was considerable oozing from the ventricular wall necessitating the use of muscle grafts. As the condition of the patient was unsatisfactory a transfusion of blood was performed. On leaving the operating table, her condition was improved but still unsatisfactory. The patient never regained consciousness and died the next morning. A necropsy was not permitted.

Histologic Description.—Section of the tumor removed at operation showed it to be a cellular growth composed of small cells, with small round or oval nuclei, closely packed together with little or no intercellular stroma. In spite of the extremely cellular nature of the tumor, mitotic figures were not seen. There was considerable thickening of the blood vessels. Hardly a vessel was seen that did not exhibit some degree of endothelial proliferation, and not a few of them showed an obliteration of their lumina.

The type cells possessed a round nucleus with well defined membrane and nucleolus and with poorly defined cytoplasm. The striking feature of the tumor was its markedly uniform appearance, and from the routine sections alone a diagnosis of oligodendroglioma was made.

COMMENT

As Bailey and Bucy pointed out, the oligodendrogliomas present a characteristic microscopic picture. They are composed of cells closely packed and extremely dense. Their appearance under low power is monotonously uniform, giving them a characteristic appearance so that they are easily diagnosed with the ordinary hematoxylin-eosin preparations. The nuclei are round and possess a well defined membrane and a moderate amount of chromatin. A nucleolus is usually visible, and del Rio-Hortega's first variant usually shows a well defined centrosome. The cytoplasm is extremely indistinct and is often difficult to see. A flimsy intercellular substance is usually visible in phosphotungstic preparations.

These tumors possess little connective tissue stroma. Around the large blood vessels, fingers of fibrous tissue spread out for a short distance into the tumor, but they never penetrate very far. The connective tissue is spread in island-like areas throughout the tumor.

Blood vessels are usually fairly abundant. They vary in frequency in various parts of the tumor. In two of our cases hemorrhage was present throughout the tumor, usually in small foci around the blood vessels but sometimes as extensive hemorrhagic areas which destroyed a considerable amount of tissue. We were unable to find any evidence of endothelial proliferation of the vessels, as described by Bailey and Bucy.

In two cases we found astrocytes in large numbers. They were most numerous in and under the capsule of the tumor and around the blood vessels. None of them appeared normal. Usually their cytoplasm was swollen and their processes were thickened and even tortuous. Within the substance of the tumor these cells were less numerous than at the periphery, but they were nevertheless fairly abundant in some regions. Huge, hypertrophied astrocytes were found in some parts of the tumor. Some of these probably represented hypertrophied forms of cells enmeshed in the tumor, while others were true tumor cells which probably developed from the spongioblasts present.

The spongioblasts constitute an interesting part of the tumors. In some portions of our tumors these elements were numerous, but this was a focal rather than a general manifestation. Both unipolar and bipolar spongioblasts were found in the tumors. The former seemed to outnumber the bipolar forms. In many cases it was possible to trace the developments of both oligogliocytes and transition forms between these elements and astrocytes from the spongioblasts. In the transition the bipolar spongioblast nucleus was placed eccentrically, usually at one pole. There then followed a swelling of the cytoplasm from which the remaining process emanated, and a splitting up of the process to form

numerous prolongations of varied length and caliber. In this way the spongioblastic elements gave rise to the oligogliocytes and to transition forms between oligodendroglia cells and astrocytes. Some of our illustrations portray clearly the development of the oligogliocytes from the spongioblastic elements, and indicate the splitting off of the prolongations.

The transition cells which are seen in the normal brain were found in rather large numbers in some parts of the tumor. These cells were larger than the common oligogliocyte constituting the greater part of the tumor, but were not quite as large as an adult astrocyte. They often had the multipolar appearance of the astrocyte, but with extremely fine, delicate processes, with no fibrillar structure. In a few instances one of these cells could be followed to a vessel to which it was attached by a long sucker process. Usually, however, these cells showed no noticeable connection with the vascular structure. The transition cells, as the term implies, possess characteristics of both astrocytes and oligogliocytes. They have the nucleus and abundant cytoplasm of the astrocyte and the delicate processes of the oligogliocyte.

The reaction of the brain to the tumor is extremely interesting in oligodendrogliomas. They are extremely slowly growing tumors, so much so that the brain has an opportunity to form a sort of protective wall against them. In one of our cases this process could be studied to good advantage. While the tumor invaded the tissue of the brain, this process was not very active, and between the tumor and the substance of the brain proper was a sort of wall composed of fibrous tissue and neuroglia fibrillae. Along these fibrous threads the tumor cells could be seen invading the substance of the brain. The astrocytic neuroglia responds to the invasion by a rather marked proliferation at the edge of the tumor, and by the formation of a few hypertrophic forms. The latter are not a predominant part of the picture, however.

In none of our cases was there any roentgen or microscopic evidence of calcium. Deposits of calcium constitute one of the most characteristic features of these tumors, yet we could find none after careful search of our specimens. Calcium, as Bailey and Bucy pointed out, may be found in any slowly growing tumor. It is not characteristic of oligodendrogliomas, but is often found within them. We were unable to find calcium in our four cases.

The appearance of the tumors in degenerated areas is rather different from the healthy portions of the neoplasm. Here one sees what Bailey and Bucy have termed "boxed-in" effects. Around each cell, or a group of two and three cells, there seemed to be a membrane that closes the cells off into compartments, giving the tissue a

honeycombed appearance. We saw these "boxed-in" effects only in degenerated portions of the tumor.

The silver impregnations in the two cases in which we had material available for study showed that the cells composing these oligodendrogliomas are oligogliocytes. These are clearly shown in the illustrations. Our work confirms that of Bailey and Bucy. The oligogliocyte composing these tumors is the small oligogliocyte that del Rio-Hortega recently classified as the oligodendroglia cell of Robertson. This cell is found chiefly along the axis cylinders in the subcortical white matter and as a perineuronal satellite. Like this cell, the oligogliocyte in our tumors has a round nucleus surrounded by a moderate mass of cytoplasm from which emanate thin processes that extend for a short distance only. Unlike the normal oligogliocyte, the cells composing the oligodendrogliomas possess no gliosomes and do not exhibit the small nodular swelling seen along the processes of the normal cell. In both cases that were specifically impregnated, we found numerous large cells in addition to these smaller oligogliocytes. The larger cells were patently not astrocytes. They represented both the simple hypertrophic forms of oligodendrogliocytes and the transition forms referred to. In none of our oligogliocytes composing the tumor could any connection be traced to the vessels.

So complete were some of our impregnations of these oligodendroglia cells that we feel able to state that the great majority of the cells composing the oligodendrogliomas are oligogliocytes. Among them are scattered astrocytes and spongioblastic elements.

There seems to be little doubt from the studies of Bailey and Bucy, and from our demonstration, that the oligodendrogliomas are indeed composed of adult oligogliocytes, among which are found scattered immature elements. These tumors are of extreme interest in that, like the astrocytomas, they are composed of highly differentiated cellular elements. That these adult elements develop by stages from other less mature cells in the tumor is seen in the presence of spongioblasts in the tumor. From these can be traced the formation of oligogliocytes. In a sense, therefore, these areas in which spongioblastic cells are found may be looked on as foci that keep supplying the tumor with cells and so swell its growth. Despite their relatively benign nature, their slow rate of growth and their freedom from evidence of mitoses, these tumors show evidences of growth. Nevertheless, they may be looked on as slowly growing neoplasms, removal of which offers some hope.

The observation in case 2 was remarkable—the presence of tumor cells in the subarachnoid space, particularly in the sylvian fissure. Whether this was the result of direct implantation is hard to say. The remarkable feature lies in the presence of a thick infiltrate of tumor

cells in what was undoubtedly an oligodendroglioma. That invasion of the subarachnoid space occurs in the medulloblastoma is well known. But such a complication in oligodendrogliomas has been unreported before now. There is no doubt that this was a true oligodendroglioma; the cells were specifically impregnated. We were unable to impregnate the cells in the subarachnoid space, however, and we therefore cannot say that they were oligogliocytes.

CONCLUSIONS

Four cases are presented confirming the work of Bailey and Cushing and Bailey and Bucy that the oligodendrogliomas are composed of oligogliocytes.

NONSUPPURATIVE ENCEPHALOMYELITIS ACCOMPANYING CHICKENPOX*

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Recent writers on the subject of encephalitis accompanying smallpox, measles and vaccinia have been tempted to include in the same group cases showing nervous manifestations in the course of chickenpox. However closely the clinical manifestations of encephalitis in the latter disease resemble those in the maladies mentioned, it is nevertheless a fact that the encephalitis following chickenpox is included in this common group on a purely hypothetic basis, as no anatomic study is available of the alterations in the brain from a patient dying of an encephalitic process in the course of varicella.[1] The pathologic changes in the cerebral complications of smallpox, measles and vaccinia are now established as being of a fairly constant and uniform appearance, but the cerebral alterations in other infectious diseases, like pneumonia, septicemia and whooping cough are varied. To attempt, *a priori*, to classify cases of unexplored pathologic pictures would seem unwise, no matter how close the similarity in clinical symptomatology. This symptomatology, as gleaned from all the accessible reported cases of varicella, can best be shown in tabular form (accompanying table). The case described herein is the first report of pathologic changes in a case of "encephalitis" accompanying chickenpox; how closely the histologic picture resembles that in cases of the encephalitis following measles, smallpox and vaccination will be discussed in some detail.

REPORT OF CASE

History.—J. F., a girl, aged 13 months, was brought to the hospital on Jan. 23, 1930, because of convulsions. The family history was essentially unimportant. Both parents were living and in good health. There was one other child, a girl, aged 5, who, on January 9, had a typical varicella eruption and who died on January 19 of a condition diagnosed by the family physician as severe scarlet

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1. Since this paper went to press, Dr. W. Spielmeyer has called our attention to an article by van Bogaert (J. de neurol. et de psychiat. **30**:623, 1930) on the anatomic observations in a case of encephalitis accompanying chickenpox which closely resembled multiple sclerosis.

fever. The details concerning this child were not satisfactory, because of the state of the mother from whom the history was obtained. The patient was born after an uneventful pregnancy; she was entirely normal at birth and weighed 9 pounds (4,082 Gm.). She was breast-fed for twelve months, and received cod liver oil and orange juice in adequate quantities. Development was essentially normal, physically and mentally. Except for occasional mild infections of the upper part of the respiratory tract, there had been no previous illnesses. The general health was excellent.

On January 19, a moderately extensive varicella exanthem had developed, the lesions being most marked on the genitals, abdomen and neck. Except for some fretfulness, the child did not appear ill to the parents. Food was taken well, and sleep was relatively undisturbed. On January 22, the parents thought that the child seemed feverish and irritable. She passed one loose stool during the day and was very restless that night. In the morning of the following day, the child vomited twice and cried a great deal as if in pain. The temperature was 102 F. During the afternoon, the baby had two generalized convulsions, the first lasting five minutes, the second about thirty minutes. The child was brought to the New Haven Hospital that evening in the midst of a third convulsion.

Examination.—On admission the temperature was 42 C. (107 F.), the pulse rate 180 and the respiratory rate 28. Physical examination revealed a well nourished and developed but extremely sick child in a generalized convulsion. The seizure was more marked on the right side. Breathing was difficult and noisy and without evident obstruction. The lips and nail beds were moderately cyanotic. The skin was dry and showed a moderately extensive varicella, which was most marked on the abdomen. There was no enlargement of the superficial lymph nodes. The head was of normal shape and the fontanels were closed. Both pupils were of pinpoint size (morphine?) and did not react to light. The ears, nose and mouth were normal. There was moderate injection of the pharynx and tonsils. The neck was not stiff. There was no alteration of the percussion note over the lungs; auscultation was unsatisfactory, coarse tracheal râles obscuring the breath sounds. The heart was not enlarged; the sounds were of fair quality with a soft blowing systolic murmur over the apex. The rate was rapid and the rhythm regular. The liver was felt about 2 cm. below the costal margin in the nipple line. The spleen was not palpated, and there were no abdominal masses. The reflexes were difficult to interpret because of the convulsions that persisted until death.

The child lived for less than half an hour after admission, when respiration suddenly stopped. The usual methods of resuscitation proved of no avail.

A postmortem lumbar puncture was done, and a clear, colorless spinal fluid containing 20 cells per cubic millimeter, all mononuclears, was obtained. Pandy's test for globulin gave negative results. Cultures of this fluid were sterile. The blood count showed 5,100,000 red blood cells, with 100 per cent hemoglobin by the Sahli method. There were 17,000 white blood cells, 55 per cent polymorphonuclear leukocytes, 37 per cent lymphocytes, 7 per cent mononuclear leukocytes and 1 per cent myelocytes. A postmortem culture of the blood was sterile.

Necropsy.—An examination was made two hours and fifteen minutes post mortem by Dr. H. W. Ferris. Over the scalp, face, chest and abdomen, and to a less extent also over the extremities, were small red blotches measuring from 2 to 4 mm. in diameter. These blotches were covered by a thin crust. In one or two places there were vesicles but no definite papules. Over the left forearm, in addition, there were a few petechial hemorrhages. Except for the observations in the brain and spinal cord, the examination of all the viscera failed to demonstrate pathologic changes.

Classification of Symptomatology and Pathologic Picture in Reported Cases of Encephalitis Following Varicella

Source	Sex	Age	Time of Onset Following Eruption	Symptoms at Onset	Course and Outcome	Cerebrospinal Fluid			Comment
						Pressure	Cells	Protein	
1. Marfan, A. B.: Bull. et mém. Soc. méd. d. hôp. de Paris **10**: 183, 1893	F	22 mo.	Few days	Bilateral ptosis; ophthalmoplegia	Recovery in few months with residual weakness of eyelids	—	—	—	
2. Menko, M. L. H. S.: Deutsche med. Wchnschr. **25**: 745, 1899	F	4 yr.	12 days	Grimacing; weakness of lower and tremor of upper extremities	Two days later tremor of head; slow speech with dysarthria; complete recovery in 4 weeks	—	—	—	
3. Caccia, G.: Riv. di clin. pediat. **2**: 817, 1904	M	3 yr.	5 days	Vomiting for 2 days preceding onset; tremor and weakness of extremities; dysarthria	Condition more pronounced on right side; hypertonicity; ankle clonus; Babinski extensor on right; complete recovery in 1 month	—	—	0.3% globulin	Spinal fluid sterile
4. Sterling, W.: Ztschr. f. d. ges. Neurol. u. Psychiat. **8**: 536, 1914	?	2 yr.	4 days	Left hemiparesis	Hemiparesis more marked following day; outcome not stated	—	—	—	
5. Miller, R., and Davidson, J. A.: Brit. J. Child. Dis. **11**: 15, 1914	M	2½ yr.	5 days	Weakness of lower extremities; generalized tremors; dysarthria; no fever	Four days later tremor more marked; slow rhythmic movements; remained excitable, but tremor completely disappeared after 1 month	—	—	—	
6. Koplik, H.: Diseases of Infancy and Childhood, ed. 4, Lea Bros. & Company, Philadelphia, 1919, p. 303	M	7 yr.	10 days	Stupor; restlessness; delirium; dysphagia	Mild hydrocephalus; paresis of all four extremities; recovery good	—	—	—	
7. Koplik, H.: Diseases of Infancy and Childhood, ed. 4, 1919, p. 303	M	9 yr.	14 days	Stupor; restlessness; delirium	Mild hydrocephalus; generalized paralysis; recovery good	—	—	—	
8. Rocaz et Lartigue: J. de méd. de Bordeaux **92**: 326, 1921	?	?	?	Choreo-athetoid movements of left arm	2	Normal	Normal	Normal	
9. Debré, Lévy-Solol, Netter and Longchampt: Bull. et mém. Soc. méd. d. hôp. de Paris **49**: 1568, 1925	F	23 yr.	1 day	Coma; stiff neck; trismus; flaccid paraplegia	Respirations stertorous; death 20 hours after onset of symptoms	Normal	0	4.3 Gm. albumin	Eight months pregnant; toxemia of pregnancy ?

10. Galli, P.: Pediatria **33**: 681, 1925	M	5 yr.	4 days	Fever; irritability	Next day difficulty in standing; dizziness; nystagmus; vomiting; complete recovery in 3 weeks	—	—	—	
11. Galli, P.: Pediatria **33**: 681, 1925	F	2 yr.	7 days	Same symptoms	Same course, with complete recovery in 3 weeks	—	—	—	
12. Krabbe, K. H.: Brain **48**: 535, 1925	M	8 yr.	10 days	Weakness of lower extremities	Increasing weakness with pain in extremities and abdomen; slight fever; stiff neck; ataxic gait; urinary retention; positive Babinski; absent knee and ankle jerks; urinary incontinence; complete recovery in 7 weeks	..	37	40 albumin; 2.3 globulin	
13. Winnicott, D. W., and Gibbs, N.: Brit. J. Child. Dis. **23**: 107, 1926	F	3 yr.	9 days	Pain; irritability; spasticity of left leg	Slight fever; spastic paralysis of left leg and arm; positive Babinski on right side; dysarthria; dysphagia; mental dulness; recovery in 6 months	Increased	0	0 globulin	Spinal fluid: chlorides, 77; sugar, normal; blood examination: white cells, 15,000; polymorphonuclears, 66%; lymphocytes, 30%
14. Wilson, R. E., and Ford, F. R.: Bull. Johns Hopkins Hosp. **40**: 337, 1927	M	9 yr.	7 days	Vertigo; vomiting	Weakness of legs; nystagmus; choreiform movements and tremors of arms; prompt recovery except for choreiform movements	—	71	0 globulin	White cells, 6,760; polymorphonuclears, 57%
15. Wilson, R. E., and Ford, F. R.: Bull. Johns Hopkins Hosp. **40**: 337, 1927 (case previously reported by Wharton-Smith)	M	7 yr.	14 days	Weakness of legs and loss of sphincteric control	Spastic paresis of legs still present 2 months later; incomplete recovery at end of year	—	2	0 globulin	
16. Wilson, R. E., and Ford, F. R.: Bull. Johns Hopkins Hosp. **40**: 337, 1927 (case previously reported by Wharton-Smith)	M	3 yr.	7 days	Paralysis of legs and loss of sphincteric control	Mild spastic paraplegia 2 weeks later; almost complete recovery 6 weeks later	—	—	—	
17. Conrad, C. E.: Arch. Pediat. **46**: 716, 1929	M	4 yr.	7 days	Ataxia and muscle weakness	Good recovery in 6 weeks	Normal	32	Positive globulin	White cells, 16,400; polymorphonuclears, 87%; lymphocytes, 13%
18. Graham, S.: Arch. Dis. Childhood **5**: 146, 1930	M	3 yr.	2 wk.?	Inability to walk	Extreme ataxia; ankle clonus on right; complete recovery in 2 months	Increased	6	Positive globulin	
19. Graham, S.: Arch. Dis. Childhood **5**: 146, 1930	M	6 yr.	19 days	Vomiting; inability to stand; positive Babinski on right	Ataxic gait; hypertonicity of legs with weakness of right; bilateral ankle clonus; complete recovery in about 8 weeks	Increased	9 lymphocytes	Normal globulin	

The leptomeninges were smooth and glistening, and beneath them the slightly flattened cerebral convolutions could be seen readily. The basilar vessels were delicate and contained no antemortem clots of blood. All of the venous sinuses were similarly uninvolved. There was congestion of the central white matter which contained small areas of discoloration like that of softenings. The position of these in relation to the blood vessels could not be determined macroscopically. Throughout the brain the cortical gray matter was distinctly demarcated from the subcortical white matter. The entire ventricular ependyma was smooth; the ventricles were not dilated. No lesions were encountered in the basal ganglia, the periventricular gray matter, the pons, medulla or cerebellum. The substantia nigra was barely visible. Portions of the brain were fixed immediately in alcohol for staining by the original Nissl method, and the remainder was fixed in 10 per cent of commercial formaldehyde.

In the leptomeninges of the cerebrum and cerebellum, particularly in the sulci, there were moderate numbers of round mononuclear cells containing phagocytosed fat granules, green and brown particles of pigment and granular material of various kinds. There was no thickening of the meninges demonstrable by the Klarfeld tannic acid-silver or the van Gieson method.

Under a low magnification the cortical cyto-architecture, with few exceptions, appeared well preserved. In rare instances only were sufficient ganglion cells absent in a single or in contiguous cortical lamina to attract attention. There was no tendency on the part of the proliferating glia cells to mask the disappearance of the ganglion cells, so that, although few, these acellular foci were rather prominent. In the insular cortex the cellular losses appeared to be most extensive and involved most markedly the third, fifth and sixth layers, sparing the second and fourth. The Ammon's horn formation suffered no greater damage than the remainder of the cerebral cortex and less than the insula. Another rather striking low power observation, which disturbed the usual cortical architecture, was the widespread staining of the processes of the ganglion cells (fig. 1). Large groups of axons from ganglion cells in the fifth and sixth layers streamed in parallel columns toward the molecular layer, and not infrequently a single axon could be traced from the sixth layer through all the intervening ones to the first layer.

With a higher magnification there was found in the ganglion cells a lesion that involved the entire cerebral cortex, and in a lesser degree involved also the central gray matter and the nuclear masses of the pons and medulla. The cells were swollen and usually had a scalloped outline. The cytoplasm stained poorly and often faintly, but there was considerable variation in the depth of staining from cell to cell. The cells that appeared to have been injured least were stained deepest, approximating the normal, whereas those most severely injured almost failed to stain. In the cytoplasm could be seen large translucent vacuoles (fig. 2), usually one or two, which displaced the nucleus to an eccentric position, and these vacuoles failed to take the ordinary fat stains. Of course there was a total absence of Nissl bodies, but occasionally the cytoplasm lacked vacuoles and had a granular appearance. In contrast to the poorly stained cell bodies, the cellular processes, as already mentioned, were stained intensely and extensively. The nuclei were swollen, round and vesicular, and had eccentric nucleoli in the form of closely grouped dark granules. In Bielschowsky preparations, the immediate vicinity of the nucleus failed to show any impregnated fibrillae, and often the fibrillae of the rest of the cell remained similarly unimpregnated. On the other hand all of the cellular processes, axons as well as dendrites, were clearly stained by this method, and frequently for surprising distances.

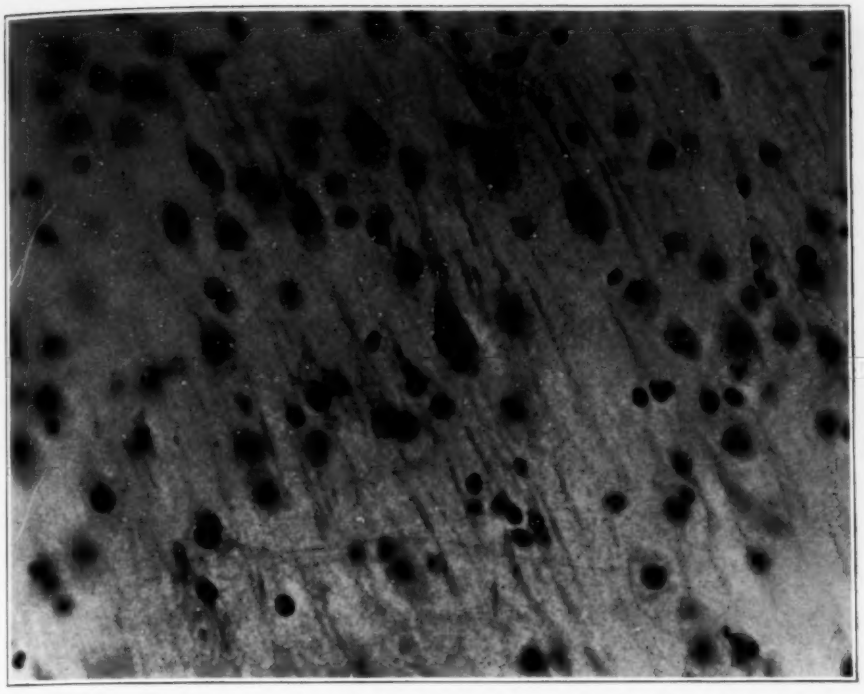

Fig. 1.—Photomicrograph of the insular cortex showing a nonspecific lesion of the ganglion cells characterized by an absence of Nissl bodies and the widespread staining of the cellular processes. Some ganglion cells are vacuolated, and others have disappeared entirely, as is manifested by the clear spaces. Nissl stain; × 500.

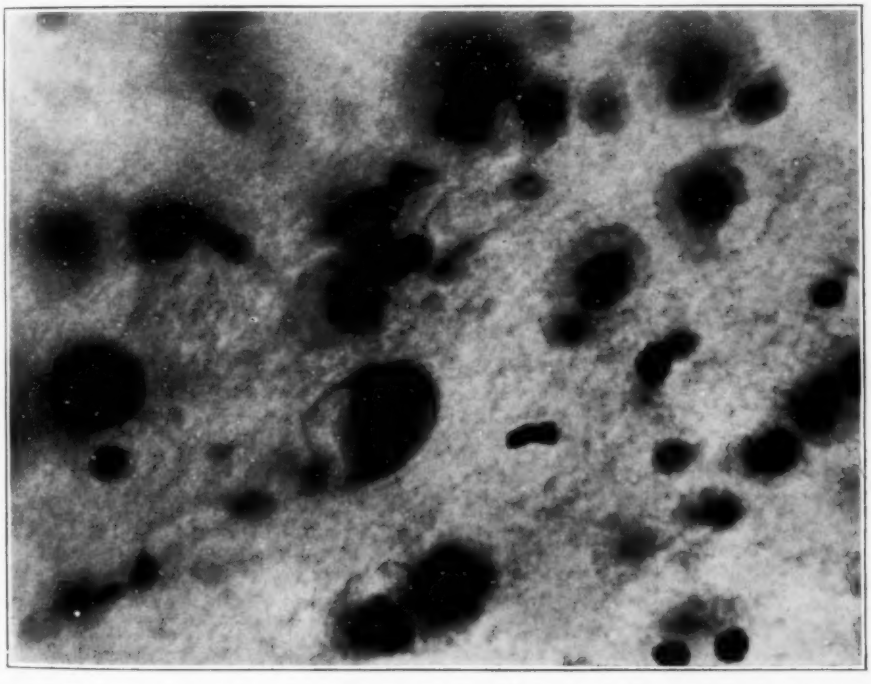

Fig. 2.—In the cortical ganglion cells are seen large translucent vacuoles which often force the nuclei to eccentric positions. Nissl stain; × 1,500.

There was no glial proliferation in the cortex, nor were there any evidences of satellitosis or neuronophagia. Mitotic figures were absent, as were also indications of the formation of a ground substance by proliferating glial processes. Increased vascularity of the cerebral gray matter could not be demonstrated.

A moderate number of the blood vessels of the cortex were surrounded by extravasations of red blood cells that distended the perivascular spaces and occasionally infiltrated the surrounding parenchyma. These hemorrhages were focal in distribution and round. Nowhere were they associated with polymorphonuclear leukocytic, lymphocytic or plasma cell reaction.

The diffuse cellular damage found in the cerebral cortex was present also in varying degree in the basal ganglia, the midbrain, the pons and medulla. The Purkinje cells of the cerebellar cortex had faintly stained bodies and large distinct processes that arborized in the molecular layer. The cells of the dentate nuclei were severely involved, and many had completely disintegrated and disappeared. The cells of the anterior and the posterior horns of the spinal cord were similarly affected, and their well stained interlacing processes formed a distinct background.

In the white matter of the parietal and occipital lobes were fairly large venules surrounded by collections of large mononuclear cells filled with phagocytosed material. These cells had round or oval prominent nuclei that were pale and finely stippled. The cytoplasm was rather inconspicuous, and no processes were seen emanating from these cells in Nissl preparations. These phagocytes lay in the vascular adventitiae, the perivascular spaces and for variable distances in the surrounding parenchyma. In Herxheimer preparations these cells were identified as fat-granule cells or "Fettkörperchenzellen" (fig. 3). The fat contained in these cells was in the form of large and small granules that stained a brick red. Fat granules that were unphagocytosed lay loosely scattered for considerable distances in the surrounding tissue. Almost invariably there was present an unstained, acellular, clear ring around each perivascular cellular "cuff." These rings were distinct in the Nissl preparations, and they were particularly noticeable in myelin sheath stains, in which they appeared as unstained, demyelinated zones (fig. 4). Fragments of myelin and thickened, ballooned sheaths in the process of disintegration were of frequent occurrence in these zones. It is of interest that the axis cylinders here as elsewhere in the brain were intact. This perivascular lesion was most conspicuous in the projections of white matter into the cerebral convolutions and more particularly in the zones of transition of the sixth cortical layer into the subcortical white matter; venules in the deeper portions of the centrum semiovale were likewise involved, but to a less degree. A striking feature was the absolute lack of pathologic changes in the vessels of the cortical gray matter proper. Vessels in parts of the brain other than the parietal and occipital lobes and those of the brain stem, cerebellum and cord failed to show the striking changes in the parietal and occipital lobes.

Stains for microglia by the Kanzler-Kufs modification for formaldehyde-fixed material failed to reveal typical cells of this type in the perivascular "cuffs." Similarly unsuccessful were the Cajal gold chloride-sublimate stains for astrocytes. Morphologically, the cells in these locations bore no resemblance to either leukocytes or plasma cells in the hematoxylin-eosin or the Nissl preparations. Therefore the conclusion must be accepted that the large phagocytic cells were either transformed microglia that became phagocytic or derivatives of adventitial cells. An explanation of the origin of similar cells found in the pia-arachnoid would appear to be that these elements had found their way into the leptomeninges along the vascular sheaths from the white matter.

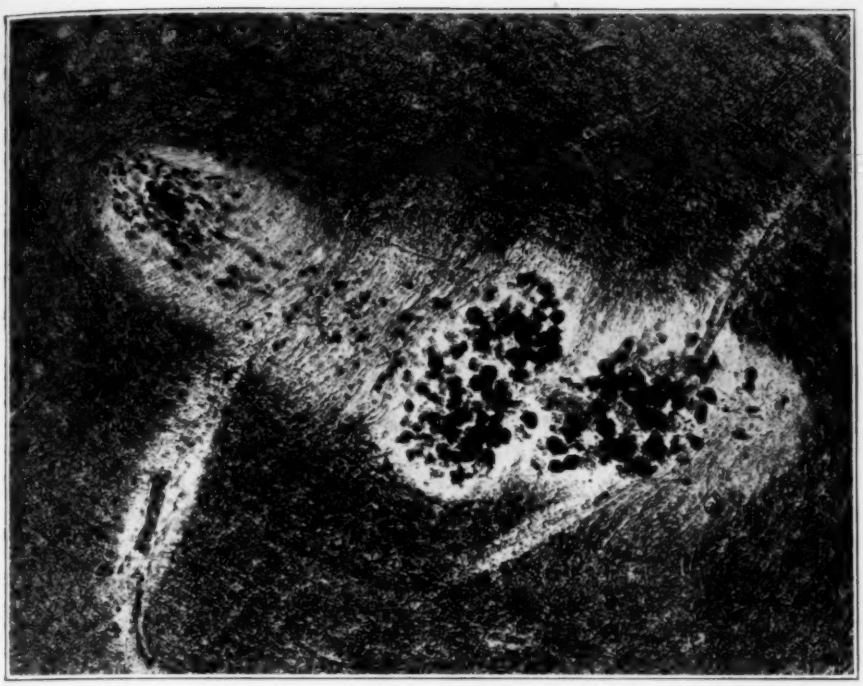

Fig. 3.—The sheaths of blood vessels in the white matter of the parietal lobe are infiltrated by numerous fat-granule cells. Herxheimer fat stain; × 125.

Fig. 4.—There is an irregular "collar" of demyelinization around the blood vessel in the cerebral white matter. Irregular fragments of degenerating myelin are present in this location. Spielmeyer myelin sheath stain; × 275.

Summarizing the anatomic changes, there was a widespread nonspecific degenerative lesion in the ganglion cells of the whole brain and spinal cord which varied in intensity, but not in kind, from place to place. There was also a diffuse perivascular demyelinization in the white matter of certain lobes of the brain associated with an extensive formation of fat-granule cells. Fat-granule cells were also found in moderate numbers in the leptomeninges. Polymorphonuclear leukocytes, plasma cells and lymphocytes did not play a part in the response to the injury around blood vessels. Occasional small focal hemorrhages were present in the cerebral cortex.

COMMENT

It is no overstatement to say that the number of reported cases of encephalitis accompanying chickenpox is not indicative of the frequency of this complication. The transitory and relatively mild nature of the symptoms has discouraged reports of cases of this condition, and in addition there is the factor of the failure to associate neurologic symptoms occurring about a week after the onset of a disease as mild as chickenpox with this disease. Nevertheless, it is equally true that the combination of chickenpox and encephalitis or myelitis is probably relatively rare.

A review of the clinical histories in the cases reported reveals the fact that in from four to five days to two weeks after the onset of the varicella eruption, there suddenly develop acute neurologic manifestations, of which muscular weakness or paralysis appears to be the most prominent feature. The lower extremities are most frequently involved, but mention is also made of paralysis of the upper extremities, ocular palsies, dysphagia and dysarthria, as well as loss of sphincteric control. Irritability or delirium are fairly constant symptoms, while stupor and mental dulness are mentioned in three of the nineteen cases. Fever, when present, is slight, rarely rising above 100 F. Vertigo and vomiting were present in four of the cases, and in four a positive Babinski sign was found. In four of the cases tremors or choreiform movements were also present. Examinations and cultures of the spinal fluid were made in too few cases to warrant any conclusions, but in Caccia's case, as well as in the one reported here, the fluid was sterile. Outstanding features of this complication are the mild course and the almost invariable complete recovery.

The time and suddenness of the onset of this complication of chickenpox are similar to those following some of the other exanthems, and the neurologic symptoms, if not so varied in varicella as in the other conditions, are nevertheless similar in many respects, though the course is decidedly milder and the prognosis better. This is in

marked contrast to the encephalitic complications of measles, for example, in which approximately 10 per cent of all patients die, and of those who survive about 65 per cent show residual symptoms.

The anatomic lesions found in encephalitis following vaccination, as described by Baumann and Bok [2] and Turnbull and McIntosh,[3] and those found in the encephalitis complicating measles, as described by Wohlwill,[4] Walthard [5] and many other writers, are characterized by perivascular degeneration of the myelin in the white matter, accompanied by a marked glial proliferation around these vessels. Active phagocytosis of lipoids is present in these zones of destruction of myelin. In these conditions the encephalitic changes are sharply limited to the white matter; there is neither destruction of myelin, perivascular glial proliferation or degeneration of ganglion cells in the gray matter. However, in the case of encephalitis following chickenpox, herein reported, the perivascular demyelinization and the accumulations of fat-granule cells are present, but in addition, there is a widespread involvement of ganglion cells and a complete absence of glial proliferation. The changes of the ganglion cells correspond rather closely to those described by Low [6] in acute, nonsuppurative encephalitis in children, but Low described a formation of glial reticulum, hypertrophy of the endothelial and hyperplasia of the adventitial cells of blood vessels, all of which conditions were absent in the case under discussion. Low also did not mention any destruction of myelin. Thus, this case of encephalitis following chickenpox had certain features characteristic of both the encephalitis following vaccination and that following measles and the nonspecific encephalitis described by Low. The conclusions that will ultimately be drawn regarding these unsettled points of classification must await further reports of the anatomic alterations in cases of encephalitis following chickenpox. A great need now exists for experimental studies on the etiology of the encephalitis of the exanthems.

SUMMARY

The history is presented of a white girl, aged 13 months, who on the third day following the appearance of an extensive varicella exanthem became feverish, irritable and restless. On the following day, there occurred two generalized convulsions, the second lasting for

2. Baumann, L., and Bok, S. T.: Ztschr. f. d. ges. Neurol. u. Psychiat. **111:** 495, 1927.

3. Turnbull, H. M., and McIntosh, J.: Brit. J. Exper. Path. **7:**181, 1926.

4. Wohlwill, F.: Ztschr. f. d. ges. Neurol. u. Psychiat. **112:**20, 1928.

5. Walthard, K. M.: Ztschr. f. d. ges. Neurol. u. Psychiat. **124:**176, 1930.

6. Low, A. A.: Acute Toxic (Nonsuppurative) Encephalitis in Children, Arch. Neurol. & Psychiat. **23:**696 (April) 1930.

thirty minutes. The child died during the third convulsion, which occurred that night. Examination of the cerebrospinal fluid obtained post mortem revealed 20 mononuclear cells per cubic millimeter. Globulin was absent, and the fluid was sterile.

The positive observations at necropsy were limited to the brain and spinal cord, and these revealed a widespread, noncharacteristic degenerative lesion of the ganglion cells, together with a perivascular destruction of the myelin sheaths in the white matter of the parietal and occipital lobes. There was extensive phagocytosis of fat in these regions and collections of fat-granule cells in the leptomeninges. Small focal hemorrhages were scattered in the cerebral cortex.

THE TIME AND LINEAGE FACTORS OF HANDWRITING

AN EXPERIMENTAL STUDY BASED ON SPECIMENS SECURED FROM TWO HUNDRED NORMAL PERSONS AND FROM ONE HUNDRED FORTY-EIGHT PERSONS WITH DEMENTIA PARALYTICA *

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If a sample of handwriting is analyzed solely from the dynamic point of view, one notes that two of the movements that produce it act horizontally in the direction from left to right. One of these—that which forms the necessary characters—manifests itself as a lateral thrust along the base line of the text; the other gives rise to the lines known as t-crossings. Because of restrictions imposed by the highly conventionalized outlines of the individual letters, the first movement develops itself largely through curvilinear forms; figuratively speaking, it may be said to be produced by the hand-arm writing mechanism while that mechanism is "in gear." The second movement expresses itself in lines that for the most part run parallel with, and above, the text. This movement is not limited by conventional restrictions and may be said to represent a to-and-fro "idling" activity on the part of the writing mechanism. By making use of a properly organized test sentence, both of these movements can be measured and expressed in terms of millimeters—the one as text-lineage, the other as t-lineage. I shall describe some of the results obtained by such measurements.

TECHNIC AND MATERIAL

I found it convenient to adopt the following test sentence: "He protested that he couldn't eat the twenty-two tarts; and the truth is that he ate twenty." It will be noted that each person who writes this sentence is forced to deal with twenty closely crowded t's. For use as a test object, the sentence should be typed on the unruled side of an ordinary library filing card, 128 by 76 mm. in size; and, as an example of orderliness, it should be typed in three lines of nearly equal length, double-spaced, and so arranged as to form a symmetric block in the center of the card. When typed in this form, the test sentence has a running text-lineage of 225 mm.

In collecting specimens of handwriting, the procedure in each instance was as follows: After the typed card was placed on the table before the person to be tested and after he had assumed a suitable posture, he was handed a library card and asked to make a copy of the test sentence in his usual handwriting on the unruled side of it. Most of the normal subjects wrote either with their own pens

* Submitted for publication, Dec. 27, 1930.

or with my fountain pen. All of the persons with mental disease, however, wrote with the same penpoint, an Esterbrook "Falcon," no. 048.

When a number of samples of script had been secured in the manner described, the records on the individual cards were scored. Of the two measurements required, that as to the total running length of the text—the value for text-lineage—was made, line by line, with a millimeter rule. The other measurement was, however, much more time-consuming, and, before it was made, in every case the specimen had to be closely scrutinized in order to note how the person who wrote it had dealt with the twenty t's. It should be explained that there are three principal kinds of t-crossings, linear, hooked and angular. A crossing is said to be linear when the bar crosses the stem of the t at right angles; before such a crossing is made, therefore, it is necessary to lift the penpoint from the writing surface. A hooked crossing is one which takes a turn about the stem of the t and then continues on to the next letter; crossings of this kind are therefore lost, or locked into the text. The so-called angular crossing occurs only on terminal t's, this term being applied to the final stroke thrown off at an acute angle from the base of the letter. T-lineage is measured only on linear t's and only on those linear t's that are free at both ends. The position of the crossing is immaterial; for if both of its ends are free, it is measured regardless of whether it is before, behind or above the letter to which it belongs. In measuring the t-lineage of a specimen, it is necessary to use a pair of needle-pointed compasses. With these, by pricking fine holes in a sheet of paper, one can readily step off the total t-lineage in a straight line. This line is then measured with the millimeter rule.

As the object of this research was simply to study two of the kinetic factors concerned in handwriting, it seemed to matter little whence I derived a supply of normal material for experiment. Nevertheless, in order that the collection might be as diversified as possible, I included in it many specimens of writing obtained from leading lawyers, prominent business executives, physicians—especially research workers—policemen and factory hands; and to this material I added a large number of other samples secured, at random, from clerical and manual workers of every description. Nearly all of my normal specimens were obtained from men.

Sixty-three of the patients with mental disease from whom I secured samples of writing were ex-soldiers; of the remaining number, fifty-four were seen at the state hospital at Napa, Calif., and thirty-one at the state hospital at Stockton, Calif. Eighteen of the patients with mental disease were women; the rest were men.

EXPERIMENTAL RESULTS

The Writings of Normal Persons.—Preliminary Considerations: 1. Spacing: How do various writers arrange the test sentence when they write it on a card? There are two characteristic methods of procedure: (*a*) The person under examination starts work at the extreme upper left-hand corner of the card and continues to write until he has finished the sentence. Such writers pay no attention to margins or to the spacing of words and often spread the test sentence over five or even six lines of writing. (*b*) The person blocks his work neatly in the center of the card, usually in three lines, and, as a rule, the words are evenly spaced. It may have been an accidental observation, but I was struck by the fact that I found many examples of orderly writing among the

specimens contributed by physicians (fig. 2, nos. 2, 4, 5, 6, 7 and 8); on the other hand, I found fewer examples of it among the specimens obtained from lawyers (fig. 1), and none at all (fig. 3) in the writings of factory hands.

2. Inclination: In a majority of the specimens all of the written characters incline forward more or less definitely; but in many other

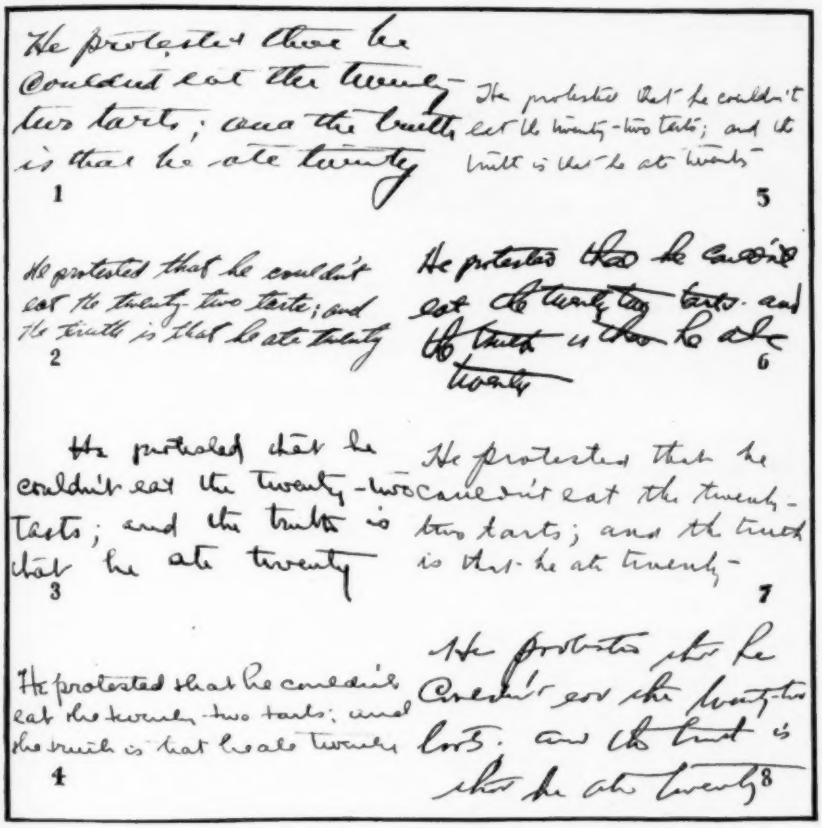

Fig. 1.—Typical specimens of the handwriting of lawyers. Note long t-crossings in nos. 1, 2, 4, 6 and 8. Nos. 2 and 5 have text-lineage values under 300 mm.

samples the long up and down strokes, such, for example, as those in the letters d and p, stand either in a stiffly vertical position or else, like the bayonets in a stand of arms, point some in one direction, some in another. The idea having occurred to me that this peculiarity might perhaps be related in some way to the various types of sinistrality, a large number of persons from whom specimens of handwriting were obtained were also tested with respect to their handedness and eyed-

ness. The results obtained seemed to show, however, that neither the dominant hand nor the dominant eye exerts a constant and definite influence on the slope of a person's handwriting. To be sure, some left-handed persons give their writing a reverse slope; but it is equally certain that other left-handed persons produce specimens of script that show the usual inclination forward. I may add that one left-handed subject, who wrote for me a beautiful forward sloping specimen,

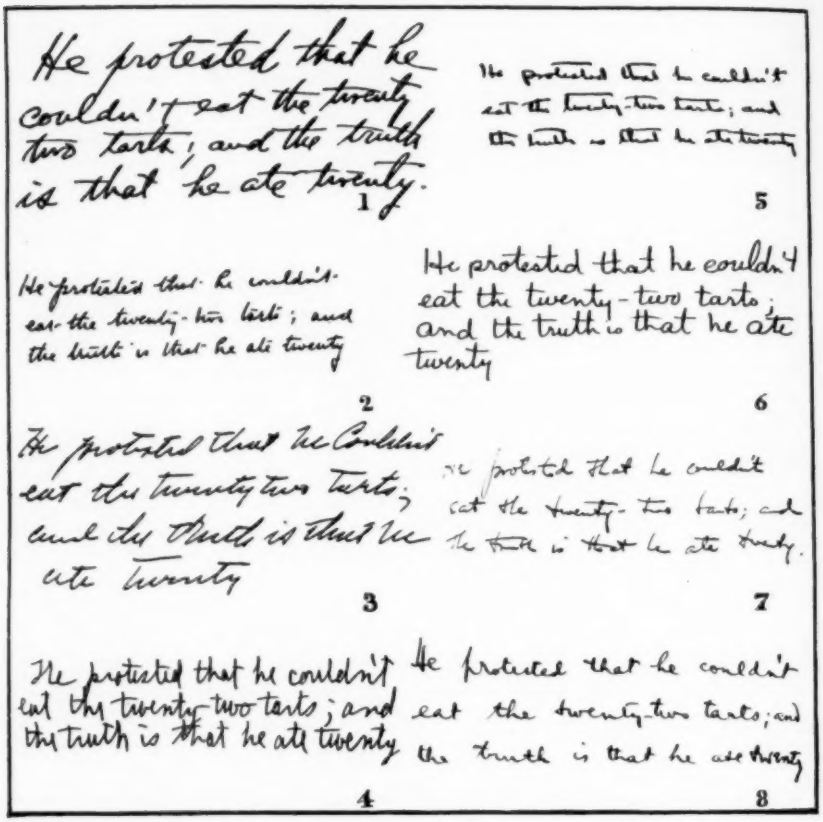

Fig. 2.—Typical specimens of the handwriting of physicians. Note the evenness of the spacing of words in nos. 2, 5, 6, 7 and 8. Note also in all, except nos. 3 and 4, the simple, printed form of the capital H. Compare with figures 1 and 3 with respect to the orderliness of the arrangement of the text. Nos. 2, 5 and 7 have values for text-lineage under 300 mm.

startled me by putting in the t-crossings in the reversed direction, that is, from right to left.

Data on Lineage: (*a*) T-Lineage: On classifying the 4,000 t-crossings contained in the samples secured from normal persons, it was found

that 3,505 of the crossings, or 87.5 per cent, were of the linear type. The highest value for t-lineage noted in any one instance, 337 mm., were measured on a specimen submitted by a lawyer (fig. 1, no. 1), while the lowest, 40 mm., was obtained from a specimen of writing turned in by a factory hand (fig. 3, no. 3). For the entire series of 200 normal persons, the average value per linear t proved to be 6.8 mm. As regards the direction, t-crossings normally run nearly parallel with the text.

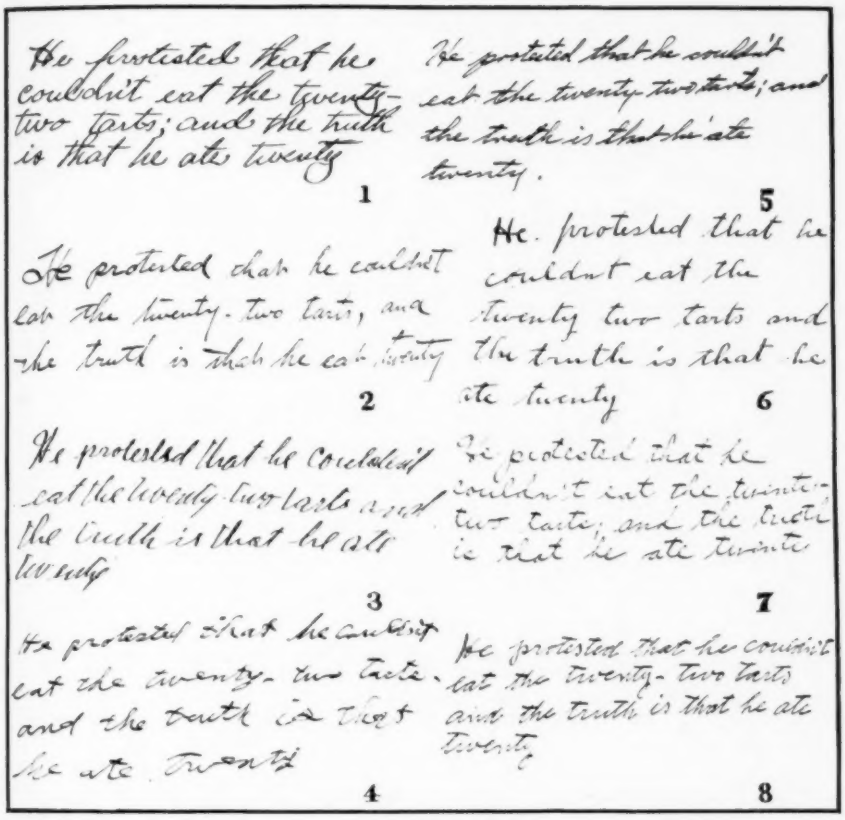

Fig. 3.—Typical specimens of the handwriting of factory hands. Note the ill formed letters and their faulty alinement. Note also that in a majority of the specimens the capital H is decorated and that the y's have return bends.

One rather unusual exception to this rule may be spoken of briefly. Among the 200 normal persons, three crossed all of the twenty t's linearly, with oblique downward strokes of about the same length. When the t's are treated in this fashion, the test sentence looks as though it had been pierced by a shower of darts. I noted this eccentricity also in 5 of the 148 specimens collected among the patients with mental disease.

(*b*) Text-Lineage: As previously stated, by judging the inscriptions on the cards simply with respect to orderliness of arrangement, it was possible to divide the normal writers into two classes: those who had placed the sentence symmetrically in the center of the card, and those who, without regard to form, had run it out into four or five lines of script. This observation seems to indicate that people differ widely from one another both in regard to their volitional control of the handwriting movement and in regard to the natural energy of the movement

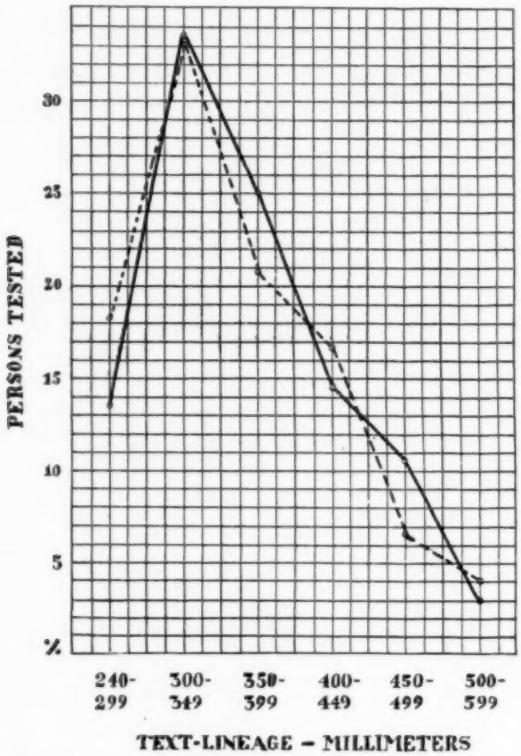

Fig. 4.—Respective scores for the text-lineage of 200 normal persons and 148 persons with dementia paralytica. The solid line is for normal persons; the broken line, for those with mental disease.

itself. Since a good many of the examples of orderly writing were contributed by physicians, the idea suggested itself that perhaps technical training tends to develop the sense of proportion. As a fact of some interest in this connection it may be stated that none of the samples of handwriting collected among pharmacists exhibited compactness as regards the arrangement of the text. However, the number of such persons examined was small.

The lowest text-lineage value [1] noted in the normal series was 234, the highest, 547 mm.; the average value was 365 mm. Further details about these values are given in the next section.

The question as to whether a relationship of any sort can be made out between the two kinds of data on lineage under discussion must, I believe, be answered in the negative. Seemingly, these data have to do with unknown kinetic qualities of the human nervous system. So far as I was able to judge from such a small number of observations, the specimens obtained from expansive, talkative persons usually had long t-crossings and more often than not also gave high TL-values—

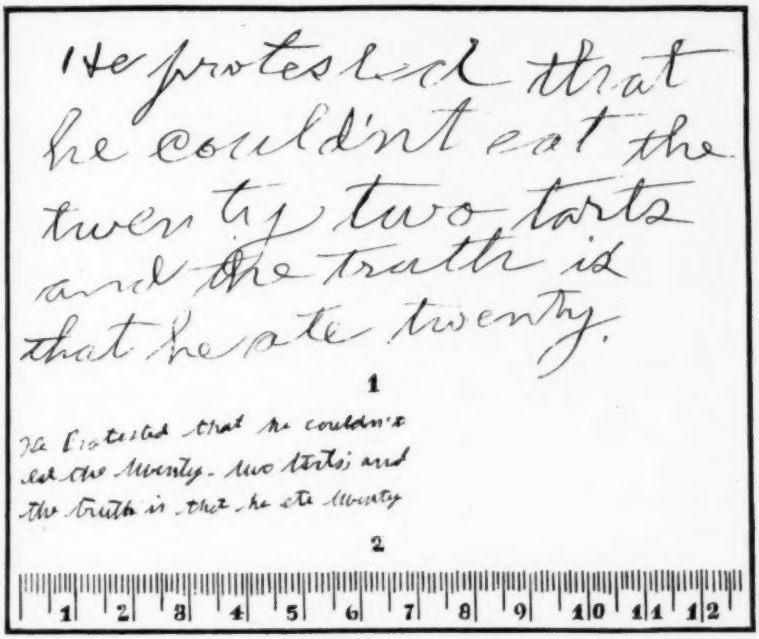

Fig. 5.—Long and short styles of writing as they occur among persons with dementia paralytica. No. 2 is a good example of a compressed sentence. Note the upward trend of the lines in both specimens.

over 400 mm. On the other hand, TL-values under 350 mm. seemed to be characteristic of reserved persons. Such persons, if they are dynamic, cross their t's with bold strokes—often with very long strokes; if, however, the writer is a slowly moving, deliberate or irresolute person, his t-crossings may have an average value under 3 mm. per linear t.

1. Referred to hereafter as the TL-value.

The Writings of Persons with Dementia Paralytica.—As the experimental results achieved through measurements of t-crossings seemed to have relatively little significance, it will suffice to state that the specimens of handwriting made available by the 148 patients with dementia paralytica yielded t-crossing figures in every respect similar to, though somewhat shorter than, those previously noted in the study of normal persons. In the normal series the average value per linear t had been 6.8 mm.; in the present series this value was 5.2 mm.

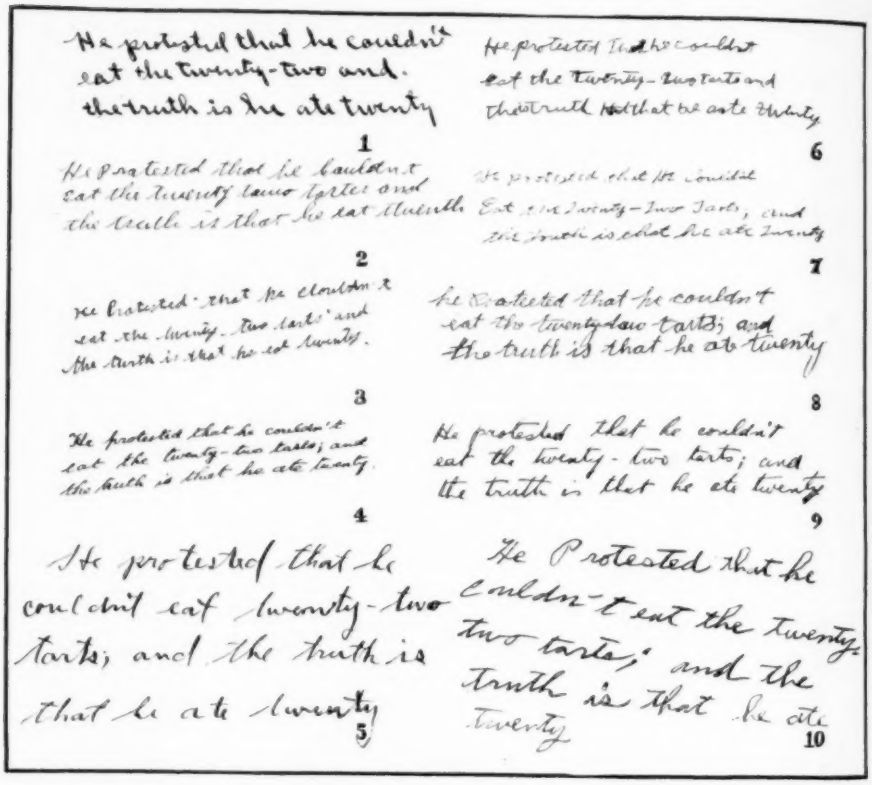

Fig. 6.—Examples illustrative of compression of the text as it occurs in the handwriting of some patients with dementia paralytica.

As compared with the handwriting of normal persons, that of persons with dementia paralytica was found to have the following five peculiarities:

1. Wide Range of the TL-Values: As may be seen by comparing the two curves of distribution in figure 4, the TL-values obtained with samples of writing supplied by persons with dementia paralytica agreed closely with a set of similar figures referable to normal subjects. Yet,

in spite of the fact that the two sets of data were nearly alike in most respects, it seems worthy of note that they differed slightly in regard to the extent of the recorded movements. The TL-values noted in the normal series varied from 234 to 547 mm., with a mean value of 365 mm., while those referable to the persons with mental disease gave values that ranged from 206 to 595 mm., with a mean value of 360 mm. The sharp contrast in appearance between the long and the short TL types of penmanship is well illustrated by the two specimens of script shown

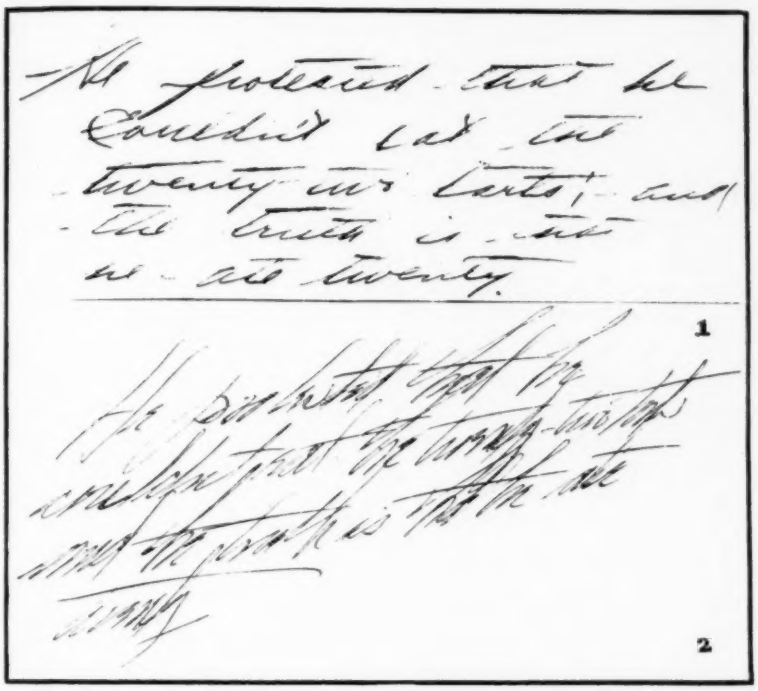

Fig. 7.—Examples of sentences that yield high values both for t-crossing lineage and for text-lineage. No. 1 was written by a normal person, no. 2, by a person with dementia paralytica. Note the upward trend of the lines in the specimen penned by the person who had mental disease.

in figure 5. Both of these samples came from the pens of patients who were suffering from dementia paralytica.

2. Compression of the Text Characters: Considerable variations as regards the fineness or coarseness of the text characters occur in the handwriting of normal persons; but none of the samples of script supplied by such persons exhibited the extraordinary horizontal and vertical compression, as regards both the text characters and the speci-

men as a whole, that was noted in some of the samples produced by persons with dementia paralytica (fig. 5, no. 2, and fig. 6, no. 4). Indeed, some of the persons with mental disease had a style of writing such as might be expected of a person capable of inscribing the text of the Lord's Prayer on a dime. This compressed type of writing contrasts strongly with the coarse, sprawling text characters produced by other patients whose specimens give high TL-values.

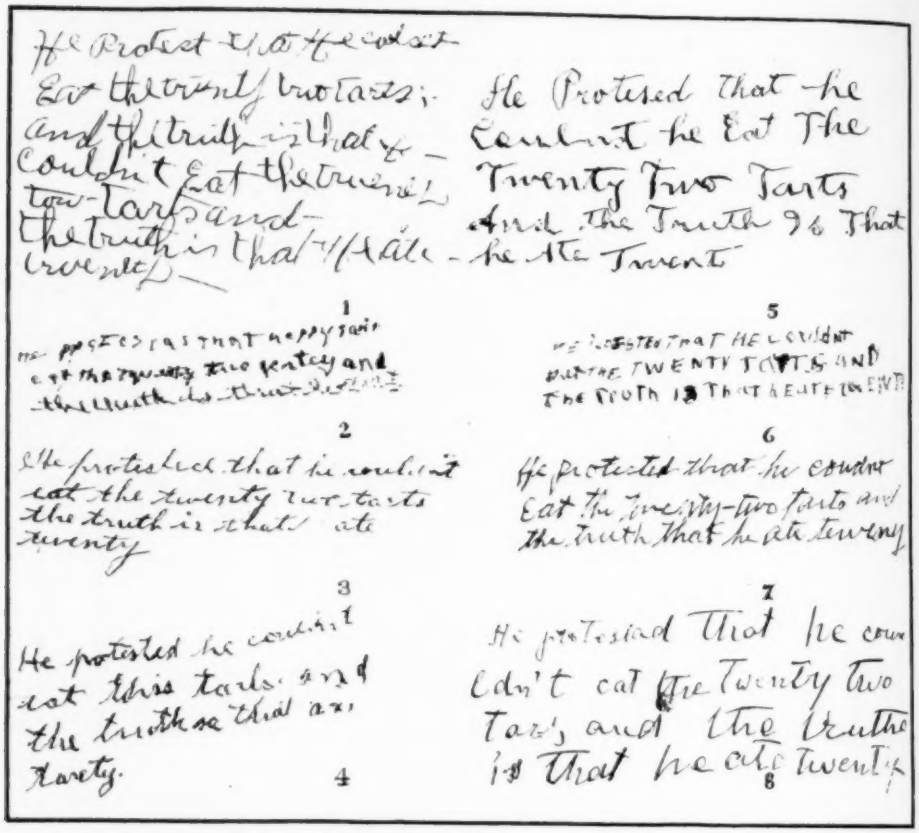

Fig. 8.—Wavering and choreiform irregularities of the text in the handwriting of persons with dementia paralytica. The wavy types are shown in nos. 1 and 5, the choreiform in nos. 2, 3 and 4. The values for the writing-time varied from three to eight minutes. Note the upward trend of the lines in many cases.

3. Upward Slope of the Text: This peculiarity occurs commonly in the writings of persons with dementia paralytica. Often, because of the upward slope of the last line, the written test sentence is distinctly wedge-shaped. Various specimens of handwriting obtained from such patients are shown in figure 6. It will be noted that with two exceptions,

nos. 5 and 10, the lines of writing there exhibited tend to run in directions more or less above the horizontal. The upward tilting of the lines is also well marked in specimen no. 2, figure 7. This remarkable bit of script has a TL-value of 401 mm.; all of its t-crossings are linear, the average value per linear being no less than 14.4 mm. Its writer, a musician and ex-soldier, was said to be extremely excitable and expansive. At the time that I saw him, he was taking the malarial treatment for dementia paralytica. The other specimen shown in figure 7 was obtained from a normal person.

4. Wavering and Choreiform Irregularities of the Text: Approximately 18 per cent of the 148 specimens collected among persons with dementia paralytica exhibited either one or the other of these peculiari-

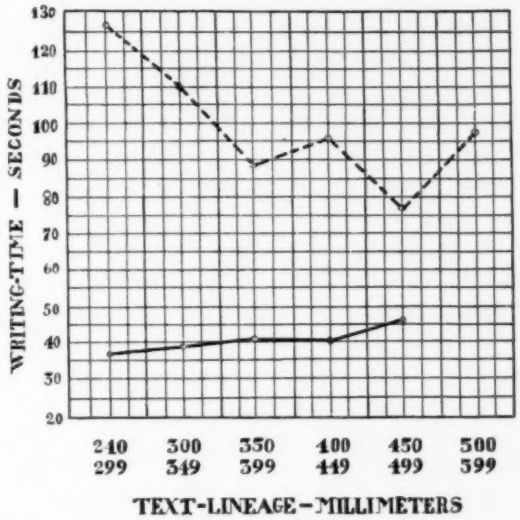

Fig. 9.—Relation between data on the writing-time and the text-lineage. The chart shows the respective scores of thirty-four normal persons and ninety-nine patients with dementia paralytica. The solid line is for normal persons; the broken line, for those with mental disease.

ties. Probably because of their greater average age, the rate of incidence was found to be considerably higher among the inmates of state hospitals than it was among the ex-soldiers. The specimens of handwriting shown in figure 8 are fair examples of these two kinds of textual irregularities, nos. 1 and 5 being examples of the wavy types, nos 2, 3 and 4 of the choreiform types. Irregular writing is always produced with hesitancy and very slowly. In a typical instance, the patient gathers himself together as for a great task, reaches out uncertainly for the pen and then, after having paused for a more or less lengthy period, begins painfully to reproduce the test sentence. Many patients who

attempted to write, however, were unable to marshal their failing powers of attention and coordination and after they had penned a few illegible words they gave up the struggle. Without going into details, it will suffice to state with respect to the occurrence of defects in the sentence that the 148 persons with mental disease omitted a total of 70 words. This fault was noted much more frequently in specimens that gave long than in those that gave short TL-values.

5. Relation to Factor of Time: Having timed with my watch the performances of a good many of the patients with mental disease, I found, on concluding the work, that there were notations of time on 120 cards. However, some of the patients with dementia paralytica were in such a deteriorated condition that their writings were useless for the purpose in hand. Indeed, even after the lapse of as much as eight minutes many of the patients had failed to complete the sentence, having spent most of the time seemingly in anxious meditation or in frequently replenishing an already dripping pen. I therefore rejected all cards that bore incomplete sentences. In this way 99 perfect specimens were secured. In order to get a set of control values, timed observations were made of the performances of 34 normal persons. The results noted in these two series are shown graphically in figure 9. In regard to the average amount of time consumed in writing the test sentence, it should be stated that the values found for persons with dementia paralytica and normal persons were, respectively, 104 and 44 seconds.

The finding of a disparity as great as this in the values for the time of writing of these two groups was not surprising, since it fits in with current ideas as to the delayed mental processes characteristic of these patients. It seemed worth while, however, to call attention to the fact that this delay was noted most conspicuously in patients whose specimens of handwriting yielded TL-values under 300 mm.

COMMENT

In view of the data set forth in this paper, it seems not unreasonable to suggest that timed measurements of handwriting may perhaps have some practical value either (1) for the purpose of establishing an otherwise doubtful diagnosis of dementia paralytica, or (2) as a means by which to estimate the therapeutic value of any given remedy used in treatment for that disease.

CONCLUSIONS

1. It has been shown by measurements of running text-lineage on a standard test sentence that the energy of the writing movement varies widely in different persons.

2. Data on lineage secured, respectively, from 200 normal persons and 148 persons with dementia paralytica gave distribution curves that agreed closely.

3. Ninety-nine persons with dementia paralytica completed the test sentence in the average time of 104 seconds; the average time for 34 normal persons was 44 seconds.

4. The highest values for the time of writing were noted in persons with dementia paralytica whose TL-values were 300 mm. or less.

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NEUROLOGIC COMPLICATIONS OF PERNICIOUS ANEMIA

EFFECTS OF TREATMENT WITH LIVER; A PRELIMINARY REPORT *

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The announcement, early in 1926, of the beneficial action of liver on the blood picture in pernicious anemia led neurologists to hope for similar success in combating the neurologic complications of the disease. Minot and Murphy [1] lent some impetus to this hope when they stated: "Improvement of the neural symptoms has often been gratifying to the patient. . . . Recently developed symptoms have usually yielded more rapidly and satisfactorily than those due to long-standing lesions." Their experience showed that, with few exceptions, symptoms of the central nervous system did not develop or grow worse after the patient had been treated for one month. More extensive experience with liver, however, in cases of subacute combined degeneration has caused profound skepticism in certain quarters as regards both its prophylactic and its remedial properties.

It was with the idea of obtaining more exact information as to the effects of the use of liver in the treatment for the neurologic complications of pernicious anemia that the present study was begun. Are the nervous complications, like achylia gastrica and glossitis, totally refractory to treatment? Can they effectually be prevented by early and adequate attention to the pernicious anemia? Can they be made to abate, once they have made their appearance? And if the response is different in different cases, are there any determinable factors that condition these variable responses? These are some of the questions on which a survey of the literature and an analysis of the cases at the Montefiore Hospital may shed some light.

REVIEW OF THE LITERATURE

The literature bearing on this subject is not scanty, yet most of the references are of little value from the standpoint of a comparative study. They consist of reports of one or a few cases that appear to their observers to bear out or to impugn the efficacy of treatment with

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1. Minot, G. R., and Murphy, W. P.: Treatment of Pernicious Anemia by a Special Diet, J. A. M. A. **87**:470 (Aug. 14) 1926; A Diet Rich in Liver in the Treatment of Pernicious Anemia: A Study of One Hundred and Five Cases, ibid. **89**:759 (Sept. 3) 1927.

liver. The student who seeks a comprehensive review of all the cases, taken seriatim, at the clinic from which this isolated report—be it pessimistic or enthusiastic—hails, remains unenlightened. The paper of Ungley and Suzman,[2] based as it is on a detailed study of thirty cases of combined degeneration in which liver was administered and on thirty-one cases observed before the "liver" era, is a notable exception and merits special attention.

The prevailing lack of unanimity as to the efficacy of treatment with liver can perhaps best be illustrated by citing the opinions of a few authors. After studying the effects of liver as a means of therapy for one and three-quarter years, Curschmann [3] concluded: "I have thus far never seen a case of pernicious anemia in which the spinal cord signs, especially the sensory, motor and reflex disturbances, were favorably affected by liver treatment." Moreover, he mentioned cases in which the neurologic signs became definitely worse during the administration of liver. In the discussion that followed the presentation of his paper, Redlich concurred in this opinion, while Lottig and Witzleben dissented. Ungley and Suzman reported much more encouraging experiences. They maintained: "Where the liver regime has been adequately carried out, improvement has occurred, not only in the general condition but also in the nervous phenomena." Numerous other authors might be quoted as supporting one or the other contention, but the foregoing juxtaposition of opinions brings out clearly the contradictory views on the subject.

Before evaluating the cases already reported in the literature, as well as those cited in this paper, the criteria by which one must gage improvement must be established. In the first place, the possibility of a spontaneous remission presents itself. It is true that certain authorities deny the occurrence of remissions in subacute combined degeneration.[4] According to Oppenheim,[5] however, occasional remissions may occur in the neurologic as well as in the hematologic aspects of the disease. Curschmann invoked this explanation to account for whatever success other observers had obtained with liver. At the present time, no one will be rash enough to deprive patients of treatment with liver to prove the point one way or the other. Reliance must be placed on the observations that were made by clinicians before liver was given. But since

2. Ungley, C. C., and Suzman, M. M.: Subacute Combined Degeneration of the Cord: Symptomatology and Effects of Liver Therapy, Brain **52**:271, 1930. (This article appears in unabridged form in Newcastle M. J. **9**:67, 1929.)

3. Curschmann, H.: Die Nervenstoerungen der Biermenschen Anaemie und die Lebertherapie, Deutsche Ztschr. f. Nervenh. **111**:151, 1929.

4. Russell, C. K., in Osler: Modern Medicine, Philadelphia, Lea & Febiger, 1928, vol. 6, p. 126.

5. Oppenheim: Lehrbuch der Nervenkrankheiten, Berlin, S. Karger, 1923, p. 254.

there is such dissension among observers, and since some critics will attribute whatever improvement is reported to a remission, it was thought advisable to discard all single case reports; in a large series of cases in which the patients were treated consecutively, the element of coincidence is negligible. For this reason, also, the extensive and comprehensive report of Ungley and Suzman appeared much more valuable than the many minor ones in the literature.

Next, the presence of a peripheral neuritis, superimposed on the pathologic process in the spinal cord, must be excluded. When the clinician is primarily interested in detecting signs of involvement of the posterolateral columns, the evidence of neuritic involvement may readily be overlooked. With greater care and precision in examination, however, the incidence of peripheral neuritis in subacute combined degeneration becomes appreciable. Thus, Woltman,[6] in an investigation of 120 cases, found an incidence of 4.9 per cent. In our series of twenty-five cases, neuritic manifestations were seen in three. Obviously, this factor is important in measuring therapeutic effects. For, if one erroneously ascribes the improvement of the peripheral neuritis to changes in the spinal cord proper, one will have a much more favorable picture than the facts warrant.

Again, one must be careful lest he mistake signs of general improvement and subjective well-being for evidences of improvement in the spinal cord. A number of investigators mention favorable changes in motor power, gait and ataxic phenomena. Since these conditions depend, partly at least, on the general strength of the patient, they are not the trustworthy signs that only neurologic examination can furnish. As instances of the latter determination there have been included in this study, changes in the deep reflexes, in the superficial reflexes, and in clonicity, tonicity, cutaneous sensibility, vibration, muscle-joint-tendon sense and sphincteric control.

Dysesthesia, consisting chiefly of a feeling of numbness and tingling in the extremities, demands a word of consideration. This symptom is present at a comparatively early stage of the disease in about 80 per cent of all cases of pernicious anemia, and in practically every case of subacute combined degeneration; of all the neurologic symptoms it yields most readily to treatment with liver. To what pathologic process can one ascribe these dysesthesias? Is their localization in the cord or in the peripheral nerves, or do they arise from some disorder of nutrition, the result of the anemia? The last explanation does not seem probable. Dysesthesias, if they occur at all in secondary anemia, are extremely rare. Moreover, the dysesthesias in cases of pernicious anemia may

6. Woltman, H. W.: The Nervous Symptoms in Pernicious Anemia: An Analysis of 150 Cases, Am. J. M. Sc. **157**:400, 1919.

occur when the anemia is not at all marked. Only recently I studied the case of a patient (case 25) who had signs of combined degeneration; her red blood cell count was 4,200,000, and the hemoglobin was 74 per cent; paresthesias were a prominent symptom. The usual distribution of the subjective sensory manifestations—in the hands and feet—suggests a lesion of the peripheral nerves. The assumption would also account for the almost invariable response of this disorder to treatment with liver. At any rate, since this question is still unsettled, it seemed wise not to consider the disappearance of dysesthesias as evidence of improvement in the degeneration of the cord.

The usual course of subacute combined degeneration before administration of liver was progressively downward, except, possibly, for the remissions already noted. The range of life after the onset of nervous symptoms was, on an average, fifteen months.[7] Continuous deterioration and early death were the rule. For this reason, in a series of cases a stationary picture as well, perhaps, as actual improvement can be regarded as establishing the potency of liver.

Turning now to the comprehensive study of Ungley and Suzman, one notes that in their series of thirty cases in which liver was given, seventeen patients were reported as improved, eight as stationary or worse and five as dead. Of the five dead, four had serious complications, and the amount of liver ingested was small. Of the eight stationary or unimproved, seven were taking no liver or very inadequate amounts (from ¼ to ½ pound [0.1 to 0.2 Kg.] a week), while the eighth developed sepsis of the urinary tract. The seventeen improved patients had been taking a substantial liver diet for from nine to twenty-seven months, the average period of observation being 16.6 months. The average duration of the pernicious anemia before therapy was instituted in these seventeen cases, was 13.7 months, a comparatively short time.

Omitting the paresthesias and ataxia as criteria, for reasons already mentioned, and excluding the possibility of peripheral neuritis, one must agree that these cases presented undoubted evidence of improvement in the signs referable to degeneration of the posterolateral columns. Treatment was given early and intensively; perhaps therein lies the clue to the gratifying results. Lest it be thought, however, that such desirable results are obtained in all cases thus treated, it must be emphasized, at the risk of anticipating somewhat, that a certain number of such patients failed to respond.

7. There is one extraordinary case on record of a patient who was observed in 1909 and showed at that time the classic blood picture, achylia gastrica and changes in the cord; nineteen years later, the picture was essentially unchanged. Liver was not responsible for this surprising result, since the patient disliked and avoided it. However, this case is a medical curiosity. (Symposium on Liver Treatment of Pernicious Anemia, Lancet **1**:892, 1928.)

A COMPARATIVE STUDY OF TWENTY-FIVE CASES

During the period from the latter part of 1926 to August, 1930, twenty-eight cases of pernicious anemia were observed at the Montefiore Hospital. All of the patients showed signs of subacute combined degeneration, a circumstance not surprising in view of the fact that almost all were admitted to the neurologic service. Three of the twenty-eight cases were excluded from the survey because of inadequate data, leaving twenty-five cases for study.

During their stay in the hospital, the patients received 200 Gm. of liver daily in addition to one vial of liver extract, the equivalent of 100 Gm. of liver. Patients unable to digest whole liver were given 3 vials of the extract daily. The average period of observation in the cases in which liver was administered was 19.8 months.

When an analysis of the cases had been completed, it was evident that they fell into two main groups: Group A: Cases in which the patients had not obtained adequate treatment with liver, either because the treatment had been instituted too late or because the liver was given in insufficient amount. There were fourteen cases in this group. Group B: Eleven cases in which the patients had been treated adequately and early. Group B could further be subdivided into: (1) six cases with a good response to treatment with liver and (2) five cases with marked progression of signs despite the administration of liver. It was interesting that the average duration of the disease before the use of liver was instituted in group A was 28.7 months, while in the more satisfactory group B, it was 10 months.

Illustrative of group A is case 2 of the series:

History.—G. F., a woman, aged 67, in 1923, four years before admission, had become pale and suffered from attacks of indigestion. In January, 1924, her "feet became unsteady." Difficulty in walking ensued, and she soon had to use a cane even for short distances. Since December, 1926, she had been bedridden. For an indefinite time she had had paresthesias in the legs and feet, together with a band of constriction about the abdomen and another band at the level of the axilla. The case was diagnosed as pernicious anemia in December, 1926. In April, 1927, at St. Luke's Hospital, signs of pernicious anemia and subacute combined degeneration were found, and she received liver twice daily for nine weeks. At home she continued to take liver three times a week. She entered Montefiore Hospital in November, 1927.

Examination.—A general somatic examination disclosed arteriosclerosis. The neural status showed involvement of the posterior and lateral columns with sphincteric disturbances. She was discharged in August, 1928.

Course.—Since the patient lived many miles from the city, an attempt was made to ascertain by correspondence her current status. In a reply written on March 13, 1930, she stated that she was unable to walk or stand; her limbs were extremely stiff; she was troubled by involuntary movements of flexion and extension of the lower limbs.

Comment.—The illness began before the "liver" era and was far advanced before therapy could be instituted.

While it is true that in six other cases of this group the disease commenced before May, 1926, also, and that therefore the patients could not possibly have received the benefit of therapy with liver, there remain nevertheless seven cases that began after this date. The failure of the patients in the latter cases to receive treatment is all the more regrettable.

Case 9 is cited as representative of this group:

History.—M. M., a woman, aged 65, in August, 1927, had suffered from an attack of "anemia." She had felt very weak and was confined to bed for two weeks. She recovered almost completely within a month, except that there was some residual difficulty in walking. About this time, she began to experience sensations as of the touch of "wet glass" and "grease" in the fingers and toes. Early in 1929, there occurred a more severe attack than the previous one; the patient was told that she had been in a semicomatose condition for ten days. The hemoglobin was said to have been 20 per cent at this time, and since the attack she had been confined to bed. During the five months before admission to the Montefiore Hospital, she received liver extract three times a day.

She entered the Montefiore Hospital on Aug. 12, 1929, complaining of no symptom other than weakness of the lower limbs; the upper limbs, distinctly involved at the time of the attack five months before, now showed little or no involvement; the paresthesias in the limbs, however, persisted. She could not walk and she was bothered occasionally by spontaneous movements in the legs. Impairment of memory suggested an involvement of the intellectual sphere.

Examination.—A general physical examination showed no evidence of peripheral arteriosclerosis, although the retinal vessels were sclerotic. The heart was not enlarged to percussion nor were any murmurs heard.

A neural examination revealed: inability to walk, with marked ataxia and hypertonus of the lower limbs; absent abdominal reflexes; bilateral Babinski responses; vibration sense lost in and below both iliac crests; position sense lost in the toes, ankles and fingers; two-point discrimination and stereognosis impaired bilaterally; atrophies and fibrillations in various groups of muscles.

Course.—During her stay in the hospital the patient developed herpes zoster along the course of the seventh intercostal nerve on the left side. On March 16, 1930, convulsions occurred on the right side of the body; the patient lapsed into coma, and died.

Postmortem Observations.—Autopsy showed arteriosclerosis of the cerebral and renal vessels, bronchopneumonia and subacute combined degeneration.

Comment.—The patient was untreated for eighteen months. The liver diet, administered for five months before admission, did not affect the weakness of the lower limbs or the paresthesias, but the power of the upper limbs did improve. Marked neurologic signs were present when the patient was first admitted to the hospital.

In this group of cases, either the patient took no heed of his symptoms and failed to consult a physician promptly, or else the physician

failed to recognize the case as one of pernicious anemia and to institute appropriate treatment. Whatever the reason, it is not fair to judge the efficacy of treatment with liver by these cases, in which, truly, there was no such treatment.

Six cases fall into group B1. These are the cases that establish the potency of liver to halt the course of the neurologic disease, and even to cause a regression in some of the neurologic signs. Case 1 is an example of this group.

History.—G. G., a woman, aged 38, in September, 1926, had become weak and experienced sensations of numbness in the fingers. The case was diagnosed as one of "pernicious or secondary" anemia. She was given medication with iron as well as a transfusion, but continued to feel weak; difficulty in walking developed. Shortly thereafter pains occurred in the hips and legs. She entered the Montefiore Hospital on Sept. 20, 1927.

Examination.—The signs were typical of pernicious anemia. There were: ataxia, diminished or lost jerks of the ankles, and slight disturbances of vibratory and position sensibility in all limbs.

Course.—The patient was placed on a liver diet, which she continued faithfully after discharge from the hospital in December, 1927.

On Sept. 17, 1930, the patient was visited at her home in Jamaica, Long Island. She was in the midst of housework and stated that she "felt fine and had been doing her own housework for the past two years." She had no difficulty in walking, except that occasionally she tended to veer toward the left. If excited, "she experienced numbness in the fingers." Otherwise she was free from symptoms.

A neural examination at this time showed: a positive Romberg sign, lost patellar and achilles reflexes, vibration sense lost in and below the iliac crests and slight impairment of the sense of position in the lower limbs. The rest of the nervous system was normal.

Case 7 illustrates strikingly the parallelism between the administration of liver and the cessation or advance of the disease. Carelessness with the diet led to disastrous results.

History.—F. A., a woman, aged 54, in May, 1927, experienced lassitude and anorexia, and her skin was lemon yellow. She was placed on a diet rich in liver and meat extracts, and felt better for the next two years. In January, 1929, she stopped taking liver because of distaste and difficulty in digesting it. In April, 1929, there appeared difficulty in walking; her legs gave way under her. One month later, she fell down stairs because of weakness. She had been bedridden since July, 1929. She entered the Montefiore Hospital on Aug. 21, 1929.

Neurologic Examination.—The patient could not walk; the patellar and achilles reflexes were absent; the abdominal reflexes were absent; there was a bilateral Babinski response; vibration sense was absent in the lower limbs; position sense was absent in the feet; cutaneous sensibility showed a level of loss for pain and temperature from the twelfth dorsal dermatome downward; there was incontinence of urine and feces. The patient died on Sept. 2, 1929.

Postmortem Observations.—Autopsy showed subacute combined degeneration and bronchopneumonia.

There was not sufficient material of the proper sort available to throw light on the problem of improvement with the use of liver as a therapeutic agent. Case 18 apparently showed a descent of the level of the lesion from the eleventh dorsal to the first lumbar dermatome, with return of the abdominal reflexes. Case 21 showed improvement of the abdominal reflexes, and of vibratory and position sensibility. The question of improvement seemed unimportant, however, in comparison with that of prevention. From the nature of the pathology of subacute combined degeneration, one cannot expect substantial improvement after the disease has been in progress for a considerable time. Axons in the central nervous system, once destroyed, cannot be made to function again. The transformation of an extensor to a flexor plantar response or the shifting of vibratory impairment from the iliac crest down to the knee are of minor significance.

That early and adequate treatment with liver is by no means an absolute safeguard against the onset of neurologic signs is a disappointing fact brought out by this study. The seriousness of this conclusion is obvious when one considers how unfortunate is the lot of patients, who, after being restored to apparent good health by treatment with liver, nevertheless are cheated of their good fortune by the insidious onset of crippling nervous disorders. Certain observers would lead one to believe that such a gloomy prospect need not be entertained. The favorable observations of Minot and Murphy have already been alluded to. One hundred and five cases which they reported were observed for from one to three years; this is a sufficiently long time to allow conclusions to be drawn, since the average time between the onset of the disease and the onset of neurologic symptoms in untreated cases is about twelve months. They found that in their cases, with few exceptions, neurologic complications did not arise. Richardson [8] reported sixty-seven cases of pernicious anemia observed for from six to twenty-eight months. In these cases, five of the patients died from infection and one of toxemia; of the remaining sixty-one, four showed marked signs of damage of the central nervous system, while fourteen had shown ataxia at the outset. In the neurologically nonaffected cases, no disturbances appeared after treatment had been instituted. I should like to subscribe to the hopeful outlook of these investigators, but unfortunately certain facts militate against unqualified optimism. In a certain proportion of cases, progression of neurologic signs will occur despite adequate treatment with liver. Isaacs, Sturgis and Smith [9] reported observations of three patients who developed such signs after the red

8. Richardson, W.: Pernicious Anemia, New England J. Med. **200**:540, 1929.

9. Isaacs, R.; Sturgis, C. C., and Smith, M.: Treatment of Pernicious Anemia, J. A. M. A. **91**:1687 (Dec. 1) 1928.

blood cell count had returned to 5,000,000. Cohen [10] reported a case in which a similar progression occurred. Brewer, Wells and Fraser [11] stated that in their experience "evidence of progressive degeneration has appeared during liver treatment." In Picard's case [12] the hemoglobin increased from 55 to 85 per cent in two months, but the neurologic signs appeared and later grew markedly worse until death occurred. McAlpine [13] treated eleven patients with pernicious anemia with involvement of the spinal cord for six months. Four patients showed slight improvement; in three the condition was stationary, and three became worse. Curschmann observed numerous cases in which the administration of liver was totally unable to avert neurologic complications. Some cases in the series reported in this paper brought out the same disappointing fact. In five of eleven patients adequately treated, marked neurologic signs developed. Case 5 typifies this group:

History.—H. M., a man, aged 51, early in 1927 had noted progressive weakness. His case was diagnosed as anemia, and he attended St. Luke's Hospital. There the condition was considered as definitely pernicious anemia; a transfusion of blood was made, and the patient was placed on a liver diet. On admission of the patient on April 9, 1927, the red blood count was 1,600,000 and the hemoglobin was 50 per cent. On discharge, on May 18, 1927, the red blood cell count was 3,200,000 and the hemoglobin was 83 per cent. He was subsequently observed in the outpatient department.

In November, 1928, the gait became unsteady, numbness of the lower extremities appeared, and the patient felt "as though he were walking on pillows." Soon after, numbness of the upper limbs set in, and the patient became so weak that he could not walk. Incontinence of urine appeared. He was readmitted to St. Luke's Hospital, where the condition was diagnosed as pernicious anemia with subacute combined degeneration. The red blood cell count at the time was 6,000,000 and the hemoglobin 105 per cent.

On Feb. 20, 1929, shortly after discharge from St. Luke's Hospital, the patient was admitted to the Montefiore Hospital.

Neurologic Examination.—The patient was unable to walk. The patellar and achilles reflexes were absent; the abdominal and cremasteric reflexes were absent; there was a bilateral Babinski response; the vibration sense was lost below the fourth dorsal dermatome, and was impaired in the upper limbs; position sense was lost in the lower limbs, and impaired in the upper limbs; cutaneous sensibility showed a level of loss of pain and temperature at the fourth dorsal dermatome. Incontinence of urine persisted.

Course.—The patient's condition became steadily worse, and he died on March 4, 1929.

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10. Cohen, A. E.: Subacute Combined Sclerosis Progressive During Remission of Pernicious Anemia, J. A. M. A. **90**:1787 (June 2) 1928.

11. Brewer, H. F.; Wells, A. Q., and Fraser, F. R.: Treatment of Pernicious Anemia by Liver, Brit. M. J. **1**:165, 1928.

12. Picard, R.: Syndrome neuro-anémique, Bull. et mém. Soc. méd. d. hôp. de Paris **53**:313, 1929.

13. McAlpine, D.: Review of Nervous and Mental Aspects of Pernicious Anemia, Lancet **2**:642, 1929.

Liver, then, was ineffective in almost 50 per cent of the adequately treated cases in preventing the onset of changes in the spinal cord. There is a wide discrepancy in this respect between the cheerful reports of Minot and Murphy, Richardson, and Ungley and Suzman, on the one hand, and these statistics, as well as the reports of other observers, on the other hand. It may be maintained that the patients whose cases are cited in this paper did not receive an adequate liver diet despite their statements to the contrary. The satisfactory blood picture argues against this presumption, however.

INCIDENTAL OBSERVATIONS

This study incidentally afforded an opportunity of investigating other aspects of the disease.

Sex.—Seventeen patients were females; eight were males.

Age of Onset.—The average age was 50; the youngest patient was 26, the oldest 65.

Duration of the Disease Before the Onset of Nervous Symptoms.—The average duration was 5.5 months. In not less than fifteen of the twenty-five cases, the nervous symptoms were the first to appear. In a control group of twenty-three cases observed at the hospital before treatment with liver was in use, the average duration was 14.8 months. This variability was also observed by Woltmann in his series of cases. He found the average time to be 10.5 months.

The First Neurologic Symptoms.—In twenty-one of the twenty-five cases, numbness or tingling of the fingers or toes was the first manifestation of the nervous complication of the disease. One patient (case 6) during the course of the illness manifested an unusual distribution of these paresthesias; they started at the proximal portion of the limb and spread gradually toward the periphery. Another patient complained of unsteadiness of the feet as the original symptom. Two others complained of weakness of the legs when they attempted to walk. The patient in case 17 had severe radicular pains along the lower ribs on the right side; these were interpreted as evidence of disease of the gallbladder. A laparotomy was performed, but no pathologic condition was found in the gallbladder.

Average Duration of the Disease.—Since many of the patients are still alive, the average duration of the disease will prove to be much greater when studied at a subsequent date. Up to the present, the average is thirty-five months.

Glossitis.—This was present in fifteen cases. In many of the remaining cases, the patients complained of soreness of the tongue, especially when eating spicy foods, but no objective evidence of glossitis was seen.

Achylia Gastrica.—The result of a gastric analysis was not stated in one case. In twenty-three cases there was no free hydrochloric acid. In one case the amount of free hydrochloric acid was questionable, there being possibly 2 per cent.

Response of Blood to Therapy.—Whenever liver was adequately taken, the blood picture was satisfactory.

Two cases (10 and 16) presented evidence of involvement of the cord when the blood picture was normal, illustrating the type of case made more familiar by the work of Russell, Batten and Collier.[14]

Pathophysiologic Observations.—While not directly pertinent to the present study, certain observations are of sufficient interest to deserve mention.

The patients in cases 2, 9, 12, 16 and 20 at one time or another during the illness complained of alternating movements of flexion and extension in the lower limbs; these have been designated as "bicycle" movements. In a letter written in reply to a follow-up note, the patient in case 2 described these movements as follows: "The sensations consist of a spasmodic drawing, commencing under the toes and extending to the waist. This condition lasts about ten seconds; then my knees straighten out. When I try to sleep at night my knees are not willing to lie peacefully; every few seconds the one, and after a while, the other, behaves the same. This may last hours, just alternating, knee upbent, then stretched." The exact anatomic basis for these movements is not known. They are observed in the transition stage of a paraplegia in extension to a paraplegia in flexion and imply, in such cases at least, somewhat more than merely involvement of the pyramidal tract.

The number of patients with level lesions was no less than ten (cases 5, 6, 8, 10, 12, 14, 17, 18 and 24). In most patients the level was in from the middorsal to the upper lumbar region; in one it was as high as the second cervical dermatome. Four patients with level lesions showed sphincteric incontinence, indicating severe damage to the cord. The proportion of level lesions appears unusually high. However, Woltman noted that in 42.4 per cent of his cases, disturbances in sensibility to touch, pain and temperature were shown.

In two cases (6 and 13), the patients were in a condition of spastic paraplegia in flexion. The anatomic basis of this condition is also as yet obscure. Observed rarely in lesions of the cerebral cortex, it is most frequent in disease of the spinal cord. Supervening as it does on a state of paraplegia in extension, it, too, implies involvement of structures other than the pyramidal tract. The two patients suffering from this

14. Russell, J. S. R.; Batten, F. E., and Collier, J.: Subacute Combined Degeneration of the Cord, Brain, 1900, p. 39.

condition showed level lesions and incontinence of urine and feces, indicating massive involvement. Since both of these patients, like so many of those with cases of pernicious anemia, were of advanced age and might have had arteriosclerosis, one cannot absolutely exclude this as a contributory factor, since postmortem evidence is wanting. If arteriosclerosis could be ruled out, however, it would appear that paraplegia in flexion in subacute combined degeneration is by no means as rare as Hall and Hirsch [15] contended. These observers stated that their case and one other are the only ones reported in the literature.

In two cases (9 and 10), local atrophy and fibrillations were manifested. Whether these cases fall into the group of subacute combined degeneration with changes of the anterior horn cells, reported by numerous observers, or whether arteriosclerotic processes play a part also cannot be decided without anatomic studies.

In three cases (12, 22, 25), sensory disturbances of a "stocking" type of distribution were shown. These cases were considered as possible examples of peripheral neuritis in pernicious anemia..

SUMMARY AND CONCLUSIONS

A series of twenty-five consecutive cases of pernicious anemia, complicated by subacute combined degeneration, was studied from the standpoint of the effects of treatment with liver. There are few reports in the literature based on a representative number of cases.

In fourteen cases therapy had been inadequate, either because the disease had started before the administration of liver was in vogue or because of negligence on the part of patient or physician.

Of eleven cases in which adequate treatment was given, signs of subacute combined degeneration developed in five despite therapy. Four cases remained stationary as a result of treatment, while in two cases some evidence of improvement occurred.

These figures indicate that in appraising the value of the use of liver as a means of therapy, neither complete pessimism nor complete optimism is justified.

Why some patients do well while others fail to rally is a problem that requires further study.

Patients who were observed before the onset of nervous complications, who were treated with liver, and in whom nervous disorders did not develop, would not, of course, be found in the wards of a neurologic hospital. These cases must be studied in institutions of a different type.

15. Hall, G. W., and Hirsch, E. F.: Paraplegia in Flexion with Subacute Combined Degeneration of Cord, Arch. Neurol. & Psychiat. **23**:257 (Feb.) 1930.

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THE RIGID PERSONALITY AS A FACTOR IN PSYCHOSES *

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To a large extent, the study of any psychiatric patient becomes, in the last analysis, a study of his personality. This subtle factor, which controls largely the mode of reaction in any given set of circumstances, is difficult to crystallize into words. A study of case histories gives one the essence of the personality which no formal alliance of nouns and adjectives can offer.

One is accustomed to look for certain lifelong traits in connection with certain well defined types of reaction. For example, in the schizophrenic reaction one looks for evidence of the "shut-in" tendency; in the hysterical, for those traits that keep the patient in the limelight, etc. Too often one's curiosity about the personality of the depressed patient is satisfied if it can be shown that the patient has always been a "worrier." It is then only a step to assume that the unfortunate state in which the patient finds himself is only an exaggeration of a lifelong tendency, and then, with the help of vague ideas of rhythmicity and statistics, to conclude that the prognosis is good for the attack, but that recurrences must occasion no surprise.

Too often in depression symptoms intervene that color the prognosis unfavorably. In this connection Hoch has pointed out especially peevishness and distorted hypochondriacal ideas. Depression trailing off into a rut of hypochondriasis is admittedly a difficult condition in which to render help.

There is another personality trait, not unique to any type of reaction, which has great significance in the etiology, course and final outcome of psychoses. I refer to rigidity of personality. It is compounded, in no fixed proportions, of many factors, such as obstinacy, aggressiveness, pride, sensitiveness, a rigid code of personal ethics, an inability to make concessions, a "hundred per cent attitude," etc. In general, the qualities are valuable, and through their adamantine nature the possessor has, in many instances, arrived at whatever measure of success is his. But these same qualities are like a two-edged sword, and many of the difficulties that beset the patient in his psychosis are directly attributable to them. Some representative case histories will best show what I mean.

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REPORT OF CASES

CASE 1.—*Depression at age of 28 over the desertion of the wife; hurt pride; attacks of rage at night; fear of suicide or violence to others; sleeplessness; anorexia; auditory hallucinations at night, shouting "Fool!"; feeling of being watched and discussed by people on the street; recovery—or stabilization—after three months through a lifelong habit of establishing another rigid attitude.*

History.—The patient was a marine engineer, aged 33, of Irish descent. Five years before he consulted me he had returned from an absence imposed by his work to find that his wife had deserted with a man whom he had befriended, taking with her all the money that he had saved to buy a home. The patient became depressed and could not work. Two weeks later, he began to have "rages" at night; he smashed the furniture, and his violence was uncontrollable. In one attack the police were called. The patient came to the clinic voluntarily, because he feared that he might hurt himself or some one else during the attacks. He complained of being depressed and lonesome, and he appeared so. He said, "I feel as if a big ball is rolling down a polished floor, and it gets larger and larger. When it gets to me, it bursts."

The patient's father, a domineering, brutal man, met an unmistakable obstinacy in the patient from childhood, and gave him the full measure of his brutality. The patient said: "He wanted to break my spirit; he wanted me to jump when he said something. I always did what he said, but would not jump at it." The patient left home at 14 with his father's jeers ringing in his ears. He never returned and never wrote home. He made his own way from the start and was proud of his ability to "take hard knocks with a grin." He married, at 15, a maid in a circus with which he was connected. Latterly, she had become extravagant and wanted to go to cabarets. The patient refused, because he thought that they were no place for a decent woman. When he was home from a cruise, he imposed his own Spartan principles on her. She deserted.

There had been no previous depressions.

The patient was honest, aggressive, independent, conscientious and wilful. He boasted of his ability to take hard knocks. He had never had to ask help of any one before, and his pride was now hurt for this reason. His own personal ideals were high, and he insisted that every one about him must conform to his code or suffer expulsion from his friendship.

The father was domineering and brutal. The mother was affectionate toward the patient, but cowed by the father. There was little mutual affection among the siblings.

The patient was small, wiry and athletic. He had undergone moderate loss of weight.

Course.—The patient was morose, moody, sullen and sneering. Appetite and sleep were poor. He wanted to be let alone. In the night he heard voices shout "Fool!" Later he felt that people on the street watched and discussed him.

Rapport was good. At first he was proud and sensitive, and resented any discussion of his trouble. Later he was able to talk freely of it, and of his own part in it with considerable insight. He wanted to push the entire episode into the forgotten past. He felt that he could find relief in work, and through his real interest in machinery and his more than willing attitude, he began to work under hospital guidance; his energy was tremendous, and he received rapid promotion. His standard of conduct at work was high; he encountered great difficulty when he tried to impose his ideas on his associates. He recognized his

peculiar driving, aggressive rigidity of character, but justified it on the ground of its results. The delusions and hallucinations were transitory.

He was thankful for the help that the clinic gave him, but left in an outburst of anger because he felt that the clinic was worried over the payment of his bill. He called on the physician later, thoroughly ashamed, and recognized that he had again been a victim of his habitual mode of reaction. When he was last seen, some time later, he was apparently well stabilized. His illness lasted three months.

Comment.—A rigid personality had been the backbone of the success of this young man. He schooled himself to believe that no knock was too hard to take standing. His wife's desertion proved the blow that shattered this belief. His reaction was depression and uncontrollable rage, and for the first time in his life he recognized the need of outside help. Paranoid delusions and hallucinations were a transient feature. Stabilization came about through the protection offered by the clinic, and the opportunity to find another center in which to crystallize the rigidity of his personality. The cure was complete; the trouble was glossed over and the patient again seemed satisfied with his code.

CASE 2.—*Depression over business losses of self and a brother, and the simultaneous illness of the wife and of the brother; development of a complex attachment to the brother; confusion; delusions regarding the wife; delusion that the brother was dead; expansion of the paranoid ideas; obstinate hiding behind a feeling of perplexity; very slight improvement after sixteen months.*

History.—A merchant, aged 35, married, the father of three children, was brought to the clinic by relatives. He presented a nervous condition affecting his brain; he worried a great deal and thought that he had committed some crime and was being pursued. Three years prior to presentation, while in business with an older brother, he had become worried and tense over financial difficulties. He felt sick, but "refused to give in" as did the brother—whom at this later date he recognized as having been depressed. His visualization became much less acute. Finally, the store was forced into involuntary bankruptcy, after the brothers had refused voluntary proceedings. This occurred two and one-half years before the patient was admitted to the clinic. The fact that the family name was "dragged in the dust" upset the patient; he "went out of the head" and declared that "everything was gone." During the next two years, the patient worked feverishly to repay some of the debts. But he was nervous, depressed, worried and sluggish; he had sleepless nights, and was tense when trying to put through a business deal. Every time he went to a bankruptcy sale he had the same experience that he had had at the sale of his own store—his mind would seem to leave.

In the fall of the year preceding admission, he took a trip to the mountains to recuperate and there first experienced easy disorientation as to place. The depression continued. He worked "automatically," was "unconscious of things" about him, and could not ascertain the meaning of things with relation to himself. At this time his brother, who was in another business that was failing, became very ill—probably depressed—and took to bed. The patient thought that the brother was dying. The patient's wife also became ill with cardiac trouble. The patient was torn between love for these two people dearest to him. He thought of mortgaging his wife's property to raise money to help his brother's store

through its trouble, although such measures were not necessary. The wife complained that he loved his brother more than he did her. He felt confused and could no longer understand what was going on about him.

He had known for some time that the sexual life of his brother and the brother's wife was unsatisfactory, but he had been led to believe by the brother that the trouble lay with the wife. However, just at this time, when his "head was in a whirl," he was told enough to infer that the trouble was with the brother. Suddenly the thought came to him "Is my brother a 'fairy'?"; he was instantly ashamed of having entertained the idea. This was followed immediately by "Rather he were dead than a 'fairy'." Then came the thought that the brother was to be killed because he was a fairy; then the delusion developed that the brother was dead, and this was clinched when he saw the nurse lift his brother's inert form on to the bed.

Shortly thereafter, he became agitated and depressed, toyed with suicide before his wife, felt that he was to die shortly, became disoriented as to place and person, and felt that his wife no longer loved him. Then came the idea that the Masons were going to kill him for divulging Masonic secrets. In this state he was brought to the clinic.

The outstanding features of the past history had special relation to the personality traits and threw great light on the illness. He was a deacon in his church; his standards of business conduct were very high and brought him into conflict with his brother, to whom, however, he deferred. His feeling toward his wife was abnormal. "I loved my wife as a mother . . . normal intercourse interferes with love with me. My love would be greater without it." He had had several premarital sexual experiences with prostitutes, which he had been able to square with his conscience. There was evidence that his wife lost caste with her family through her marriage and her loyalty to him. He was deeply attached to his brother, because the latter had protected him from childhood up. He was very proud of his achievements in the business world, and his pride was greatly hurt when he was forced into bankruptcy.

His first knowledge of homosexuality came by chance through meeting a man on a train who made some tentative advances which the patient did not understand. When he related the incident to a friend later, the latter told him that the man was a "fairy" and told him of the homosexual practices of some business men. The patient was horrified by these stories which related to fellatio and withdrew his business from one of the men so implicated.

There had been no previous depressions. The illness that he presented had lasted for three years. There had been no particular tendency to swings of mood.

The father was a "spree" drinker. The mother dominated the home. She had warned the patient against drinking, and ever after the patient felt guilty when he took a rare drink. His mother died when the patient was young, and several years later when the patient passed the house in which she died, he heard the lamentations of the children "as plainly as on the day she died." An older brother was the protector and business partner of the patient; he was of manic-depressive type. The two illnesses, already referred to, were doubtless depressions, and while the patient was at the clinic the brother was under observation in another clinic in a hypomanic state. The other siblings were well, and there was no other evidence of mental disease in the family.

Physical Examination.—The patient was of an athletic habitus. There had been some loss of weight. There was congenital amblyopia of the left eye.

Course.—On admission to the clinic the patient was tearful; he read the Bible constantly, talked of his sins against the Masons who were to put him to death,

of being willing "to pay the price" and of "a man's honor being above all;" he felt that the end was near. There were no hallucinations. There were diffuse paranoid ideas: he believed that the papers were printed for him and that his letters were faked; he had a paranoiac's intuition. At first there was a marked reversed depressive diurnal variation of mood. He was considered actively suicidal.

Gradually, the depression became less; it was topically determined by the three main delusions regarding his wife's love, the death of his brother and his "obligation" to Masonry. After he had been in the clinic about a year, he experienced a hypomanic swing, lasting two weeks; after this everything became "clear," but he slumped again after a telephone call from his brother, who was then hypomanic.

The mood, except when frankly depressive as a reaction to his delusions, was one of perplexity as to what might have happened when he was confused before admission to the clinic; at times he was even cheerful. The swings of mood were wide and rapid.

Toward the latter part of his stay of sixteen months in the clinic, the mood improved; he recognized the previous depression and the hypomanic swing as abnormal. At times the delusions seemed less firm when he was depressed and reappeared as the mood approached the normal. Often he appeared ashamed of them.

He was at the clinic for fifteen months before it was possible to gather the facts of the illness that related to the delusions and to the early depression. He offered them only with great reluctance, saying that he alone knew the secret of his illness, but that he would go to the grave with it. He hid behind his feeling of perplexity and seemed unable to talk frankly. There was some evidence of passive homosexuality in his activity in the clinic. He seemed to welcome a discussion of homosexuality and accepted the more benign phases of it as his own reaction toward his brother. The delusion regarding his brother finally left with a "snapping in the head." When he left the hospital, his mood was normal, his delusions were subject to great doubt and there was a certain anticipation on his part of a final abolition of them through residence in a hospital nearer home. At this time he denied betrayal of Masonic secrets—at least intentional betrayal—and hoped that he would not be held accountable for his actions while he had been confused.

He was especially glad that at last we at the clinic had been able—as was his wife—to make the distinction between his depression, "the natural sickness," and the delusions, "the unnatural sickness" he based his hopes of recovery on the recognition by his friends that the delusions had come on him while he was sick and unaccountable.

Comment.—This case is extremely complex and understanding of it will be only partial at best. Several factors stand out clearly, however. The patient had a definite manic-depressive hereditary taint, and during a reactive depression a specific tendency to a confusional state developed. While in this condition he discovered in himself a complex attachment for his brother, and his immediate reaction was the elaboration of a haunting delusional system involving this brother and the patient's wife. Later came an expansion of the paranoid system to include Masonry, the clinic, etc.

Throughout the illness the affective and biologic features of depression (and hypomania) were prominent, and the fixity of the delusions varied partially with the swings of mood. It is noteworthy that the patient himself recognized the distinction between his depression—which was of long standing—and his delusional system.

The patient's personality, as expressed in his inordinate pride, his "honor," and his strict ethical code which admitted of no infractions or alteration, showed a rigidity truly remarkable. His concern over the failure of his store and later over the failure of his brother's store was to a large extent hurt pride that the family name was "dragged in the dust." He never recovered from this blow. He recoiled from the discovery of his attachment for his brother by a protective delusional system which was probably facilitated by his specific tendency to confusion. Duty and honor were his standards. He could not face the prospect of going home until all had assured him of their belief in his ethical integrity, and especially of their realization that whatever he may have done wrong (e. g., against the Masons) was done while he was already sick (with a depression). Help, scant as it was, came largely through a discussion of his personality with him, and in his attempt to accept the fact of his attachment to his brother as laudable but unwise in view of his responsibilities to his wife and children.

This case is much more serious as to length and prognosis than case 1, but it has the same sort of factor at the base. The paranoic development represents probably the best example of the rigid personality in trouble. Its incidence here in an unquestionably depressive setting is noteworthy.

CASE 3.—*Gradual loss of interest in work; difficulty in concentration; general indifference and pessimism at age of 30; a sudden burning feeling in the penis and head after becoming engaged; hypochondria; a sense that the success, of which the patient was proud, was due to a driving, one-track personality; a feeling of being doomed; retrogression one year after the acute onset; complete pessimism as to the future; worried and haggard aspect; five months later, improvement and insight.*

History.—A man, aged 30, a cashier of a bank, was admitted because of restlessness, tenseness and inability to carry on his work because of difficulty in concentration. He had been well until after a tonsillectomy four years prior to admission. The anesthesia was a nightmare to him, and he felt that something had been taken from him. The first thing that he noticed was a resentment toward his fiancée, a girl for whom he had no particular feeling, but to whom he felt obliged by his standards to stick. There followed hypochondriacal complaints. His work seemed less interesting, as did the world in general. Finally, six months before admission, he broke his engagement and became engaged to another girl whom he loved. He looked on this act as a breach of ethics. There followed immediately a psycholeptic episode with pain in the penis and a snapping in the head. He was confused temporarily. Then work became very hard, he

made a few mistakes and asked to be relieved. He had his accounts audited and they were in order. He lost interest in everything; he lost weight and sleep and all sex desire. He could not read a book or follow a movie plot. At times he thought that he was insane. He blamed his trouble on a "jammed emotion-fear." There were many hypochondriacal complaints.

In the past history the patient's personality stood out clearly. He came from a humble home and through hard work he had become the cashier of a bank at the age of 20, and then, through sheer ability, drive, business integrity and an unremitting attention to duty, he had become a local financial figure of some importance. He was slated for the early presidency of the bank. His creed embraced work and honesty—only these. His code of personal ethics was high, and he rarely faltered. His attention to work included the work of every one else—he could delegate no details to others. He was intensely religious. He had been well until the present illness.

The patient was aggressive, honest, hardworking, conscientious, rigid in ideas of business and social conduct, with a one-track purpose, unable to make concessions, proud and religious. He was of an athletic habitus.

The family history was without significance.

Course.—The patient showed indifference with a marked tendency to a pessimistic philosophy and outlook on his own and on outside affairs. To him the world seemed headed for utter ruin. The stock market crash depressed him, although he had no personal stake in it; it simply strengthened his convictions that all was wrong. He talked constantly of the suicide of a number of his friends after illnesses similar to his own. His hypochondriacal ideas were numerous and fixed, especially sensations of pressure and contracture in the head. He spoke of a "disparity between mind and body," meaning that his body could still do things in which his mind could no longer participate. He tried hard to keep up with the schedule of activities in the ward and appreciated all efforts in his behalf, but was totally unable to see any hope. He had some better days when he was almost cheerful, was free from the sensations in the head, and talked of his plans if he should get well. He left the clinic against advice after four months, and when he was seen three months later, he was as firm as previously in his conviction of his doom; he looked haggard and worried, had lost a great deal of weight, and his distorted hypchondriacal ideas were just as fixed. He had given up all hope of returning to work at the bank, and was thinking of taking up some sort of minor clerical work.

Two months later, he returned for a consultation, with an entirely different picture. He stated that things had come to a climax about a month before, when for a day he was confused, thought he was dead, and at night slept with his mother for protection. Immediately he began to improve, and his progress had been steady. He was smiling, and said that he was less pessimistic about himself, although he still saw America headed for the rocks. His bank had accepted his resignation as cashier, but had made him vice president, and he was working part time at the new work with some interest. He noted that he was indecisive. If he concentrated hard the sensations in the head returned, but they were less marked. He was interested in gardening, golfing and fishing, and seemed proud of the fact. He had gained weight and was less concerned with his somatic status. He said that his trouble had consisted of too great a pride in himself, and unexpressed emotions. His attitude toward his engagement was much more hopeful. He regarded the psycholeptic phenomenon as a mystery, but was able to see that it was the climax to a long history of dissatisfaction with his environment (and with himself?). The signs of improvement were striking.

Comment.—This young man had come to considerable local prominence through the exercise of the personality trait of an unbending, rigid, one-track devotion to a cause. This cause was losing some of its luster when an affair of the heart arrived which demanded new perspectives and new rules. He tried to apply the code of ethics that had brought him success in business to the situation, and failed. There resulted a psycholeptic phenomenon, followed by pessimism and difficulty in concentration because of sensations of pressure and contracture in the head. The biologic features of depression were present, and they improved during his stay in the clinic. The patient sensed the rigidity of personality that hedged him in, but could make no effort to break through. He said: "I carried all my eggs in one basket." The hypochondriacal rut was prominent. He lapsed into a feeling of hopelessness, because of the sensations in the head which blocked all his efforts to return to work. Efforts to make him accept work of a routine nature while under care at the clinic resulted in his leaving the clinic abruptly. His attitude was that he would either do his former work or nothing. Three months later, he definitely gave up hope of returning to his old work. A month later, however, he reached a climax, and thought he was dead. After a night in bed with his mother he began to improve, and in every respect this improvement was steady. A month later, five months after leaving the clinic, he showed striking objective and subjective improvement in the depression, was cheerful, smiling, more interested in a number of things, and able to work part time at a better job. He ascribed his trouble to too great pride in himself.

Of a rather different type are the next two cases.

CASE 4.—*Depression over business affairs, at age of 56, while invalided with a fracture of the femur; difficulty in concentration, agitation, depression, suicidal preoccupation, fear of insanity, tearfulness, insomnia, anorexia and loss of weight; inability to accept the illness as such; belief that the depression was caused by drugs that had been taken; continual fretting; transient hypochondriacal complaints; slow improvement, later complicated by real financial troubles, followed by an exacerbation and a return of stubborn aversion and paranoid ideas against the wife.*

History.—A manufacturer, aged 56, fractured a femur a year before admission to the clinic, began to worry over financial troubles of his company, became depressed, sensed a loss of concentration, and had to give up work and seek medical aid. The depression was characterized by great restlessness, agitation, tearfulness, fear of insanity, suicidal preoccupations, worry over business affairs, and marked loss of weight and appetite. There was considerable diurnal variation of mood.

The patient, after a fair education, had done engineering until he was 30, when he became interested in a manufacturing concern, in which his business stake was considerable. The company had been losing money for some time. His outside

interests were in yachting and theatricals. His wife was twelve years his junior. The patient was never very active sexually. There were no children. There had been no previous depressions.

Personality: The patient had had "blue spells" lasting for two or three days for many years. He was proud, ambitious and sensitive; he was never satisfied with himself, and his feelings were easily hurt. He was outgoing and active socially, and had many friends. His mother was a "worrier." Two brothers had committed suicide. Another brother was paranoiac, and was in a state hospital.

Physique: He had an asthenic habitus and had undergone marked loss of weight.

Course.—The patient was tense, restless and hypochondriacal, and he feared insanity. The outstanding features were a total inability at first to accept the facts of the illness. He fretted continually and wanted to leave, and invented reasons in the weather to account for his depression. His course was parabolic, and the upgrade was favored by a more lenient attitude toward his own illness, as was shown objectively in a lessening of the restlessness and in hypochondriasis and improvement in the physical status. His aversion to the illness never left him entirely, and at last, after four months, he left the clinic against advice. He did well for a short time and worked in his office, all the while facing a trying financial situation. He then began to complain again, felt depressed, and was operated on for disease of the gallbladder. Thereafter the depression increased; he toyed with suicide before his wife, and four months after leaving the clinic he had to be returned to a sanatorium. He declared himself a well man at this time, and said that his wife was trying to get rid of him.

Comment.—This patient, whose heredity was heavily tainted, was in his first depression. The motility features were restlessness and agitation. The biologic features were marked. He was a proud, ambitious and sensitive man. He never was able to accept the need for hospitalization. Improvement was coincident with a change in attitude. The aversion to the facts of the illness became less unrelenting, but he was never able to make the most of the total situation. This culminated in his leaving the hospital. This personality factor was a deterrent to recovery fully as important as the real financial difficulties in which he found himself. Four months after leaving the hospital he was back in the same rut, with suicidal tendencies, but declared himself well and misused by his wife.

CASE 5.—*Depression, at age of 56, following business worries; uneasiness, preoccupation, depression and inability to think; loss of weight and of sleep; fear of harm to wife and fear of being taken to an asylum; no improvement in ten months; virtual mutism and resistance; return of an old torticollis; refusal to accept the illness; reference to the hospital as a jail; eager departure for another hospital; two months later, worse and leading a "vegetable existence."*

History.—A manufacturer, aged 56, was brought to the clinic by his wife. For a month he had been depressed and preoccupied following the discovery of a shortage in his cashier's accounts. He began to fear that the police were after him in connection with the shortage of money, that harm was to come to his wife, and that he would be placed in an insane asylum. Torticollis, from which

he had suffered in a previous depression, returned. He was in a general hospital for a short period and was brought to the clinic rather unwillingly, on the advice of his physician.

The patient's stubborn, rigid personality was clearly shown in the past history. After leaving business college he started a factory and was successful. Seven years later, he suffered a severe financial loss through fire and was advised to take advantage of the bankruptcy laws, but refused and rebuilt the business. He became one of the pillars in the community, was consulted on matters financial and political, and was an ardent churchman, writing articles for the papers defending his religious views—something in the nature of a crusading moralist.

At the age of 42, following a financial loss, he became depressed and anxious, and complained of feeling "blue." He was taken to a hospital which he left after a month because he began to fear that he would be placed in an asylum. He expressed a strong antipathy for hospitals and physicians at that time. A spasmodic torticollis developed which left him a year later when the depression lifted. During that time he was at home, unable to work.

The patient was overconscientious; sociable, though with few close friends; cheerful, calm and rarely angry. He was sensitive to criticism, but free in his criticism of others except his family; he was doggedly persistent and stubborn. He was always afraid that some harm might befall the family. He was proud of his social and economic position in the community, ardently religious and moralistic. His mother was depressive. A half-sister had been in a convent since the age of 20.

He was of an asthenic habitus. He had suffered a moderate loss of weight. Arteriosclerosis was not a marked feature.

Course.—On admission to the clinic, the patient looked depressed, and complained of "general depression" and inability to concentrate, to line up his thoughts; he added that he had been in a similar state of depression fourteen years before. He said: "I dreaded going to an insane asylum. I feared a pickup (by the police). I knew that a man of my type would be sensitive. I dreaded to form a contact with the slime of the earth." He admitted a feeling of hopelessness. He tended to blame the "bewildering situation" for his complaints. He recognized the "nervous breakdown" as growing out of financial worries, but as being something additional.

Within two days after admission, the rapport which had been good was lost; he felt that he, "a perfectly sane man," was detained by the physicians against his will, that he was jailed with Negroes, and that his body was to be tortured and finally used for medical purposes. He became practically mute.

On the fifth day in the hospital he attempted suicide by jumping before a street car, to escape the tortures that he anticipated. He claimed that his food was poisoned, that he was not allowed to sleep in his own bed, that his visitors would never be able to leave the ward, etc. The torticollis was unchanged except that it was more pronounced when he was watched.

He was an extremely difficult patient. He refused food, but at times took it if the attendant moved as if to take it away. He resisted all physical manipulation, and toward the end of his stay seemed to have a special aversion to having his pulse taken. His characteristic attitude was sitting in a chair, his head turned backward and to the left, and the chin supported in his hand, or standing near the bed, shifting from one foot to the other, all the while keeping a wary eye on the activities in the ward. He was sensitive about being seen in hospital clothes. He refused to see his wife in the ward, but had to be dressed in his own clothes and taken to the reception room. He talked freely to her, but always in a depres-

sive vein. At such times attempts by the physician to draw him into a three-cornered conversation were fruitless. He read his Christmas cards only when he thought he was not being observed by the hospital staff. He spoke occasionally to the nurses and attendants, expressing his anticipation of terrible torture at our hands. He was particularly annoyed by the occupational activity in the ward, referring petulantly to "those weavers." He often voided urine on the floor or in his bed without any explanation.

During the last few months in the clinic he did not appear depressed, merely stubborn. One day when asked why he was wearing glasses (he rarely did), he answered: "For the same reason every one wears them," but refused to read the papers brought to him.

After eight months in the clinic he was again visited by his wife; following this visit he improved slightly; he voluntarily went for walks, but always wanted to stay outside the ward; he dressed and undressed himself, and asked occasionally for food and drink. However, to the last he established rapport with no one, and was bitterly antagonistic to the clinic. He left after ten months, practically unimproved. When the opportunity was offered him of going to another hospital of his own choosing he accepted it eagerly, declaring he was not yet well enough to go home. Two months later, reports from this sanatorium indicated that he was leading a "vegetable existence," was mute, resistant, and remained in bed most of the day, but showed little objective evidence of depression.

Comment.—In this recurrent depression in an elderly man, with precipitating factors in a financial loss, as in a previous attack, an inability to accept the illness as such and the need for hospitalization were prominent symptoms, leading to a marked aversion reaction with torticollis, mutism, resistance and complete lack of rapport.

There is no doubt of the underlying depression in this case, and the biologic features of the depression, as well as the objective evidences of the depressive mood, e. g., the facial expression, underwent some improvement in the clinic. But the rut formation of stubborn aversion can clearly be attributed to the proud, sensitive, rigid personality, and this personality factor was unalterable as far as efforts in the clinic were concerned. It is interesting that in the previous depression the patient recovered one year after leaving a hospital against advice, when he showed a similar antipathy to hospitals and physicians.

It is of interest to compare this case with case 4 in regard to the lack of insight. In case 4 the motility component was a marked restlessness and agitation; in this case these factors, prominent early in the illness, gave way to the more static picture of aversion. It was as if the patient's attitude to the whole situation was cast in the mold of stubbornness, resistance, mutism and torticollis.

COMMENT

The cases presented form a heterogeneous group. In all, however, the factor of an inelastic personality setting is prominent. It has been my purpose to separate the features of the psychotic "process" from

those attributable to the personality. An attempt has been made to show how certain traits, such as pride, aggressiveness, sensitiveness, honesty, etc., have operated in the life histories of these patients, determining certain reaction patterns and attitudes and also bringing about certain successes. For one reason or another, a psychotic reaction such as depression occurred. This may be "reactive" or "endogenous." In some of the patients the psychotic process was doubtless facilitated by a heavy hereditary taint. In all, however, the same personality traits are seen, sometimes favoring, but more often hindering, recovery from the psychosis. Anger, aversion, stubbornness, paranoid delusional systems and rut formations of all kinds are some of the manifestations of the rigid personality in trouble. This vein of inelasticity in every case jeopardized the happy outcome of the psychosis, sometimes introducing complicating features which in the cases here reported cast grave doubts on the diagnosis of depression as the essential process.

These personality factors cannot be overlooked in the treatment for the underlying psychosis. Personality factors are treated only through studies of personality, and this procedure is especially difficult in these cases. In general, the aim is to socialize the patient, to introduce new points of view for his consideration. It is in the nature of a limbering up process. The results are generally meager, but one is occasionally helped by an unusual degree of insight or of rapport, or by a real desire to get well.

NONSUPPURATIVE, NONEPIDEMIC ENCEPHALITIS FOLLOWING LABOR AND IN THE PUERPERIUM

REPORT OF A CASE PROBABLY DUE TO CEREBRAL ANOXEMIA, WITH A REVIEW OF THE LITERATURE *

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A case of cerebral complication in the form of a nonsuppurative, nonepidemic type of encephalitis which was encountered immediately after labor presented serious diagnostic and therapeutic difficulties. A search of the literature disclosed that the condition is relatively rare and that the subject is in a state of confusion. Therefore, it was deemed justifiable to report the case in detail and at the same time to review the literature on the subject with an attempt at clearer orientation.

Neurologic complications of labor and the puerperium constitute an important group in neuropsychiatric practice and have received relatively little attention in the literature. Among the cerebral complications that have been reported are hemiplegias, thromboses of cerebral veins and sinuses, puerperal aphasias, tumors of the brain and "pseudotumors," chorea, visual disturbances, meningitis and epidemic encephalitis. Hardly any mention is made of nonepidemic, nonsuppurative types of encephalitis in relation to pregnancy, labor or the puerperium. Even epidemic encephalitis is discussed largely in relation to its occurrence during pregnancy, and relatively few cases are reported in which the epidemic encephalitis made its first appearance after labor or in the puerperium. Thus, Alpers and Palmer [1] found that of 35 cases of epidemic encephalitis in the literature and 2 cases of their own, only 2 occurred in the puerperium, while 35 were observed during pregnancy. In the latter, the average time of gestation at which the symptoms appeared was 6.85 months. In an exhaustive work, Roque [2] analyzed 171 cases; 58 cases occurred during the first half of gestation with a mortality of 48 per cent; 91 occurred during the second half of gestation, with a mortality of 39 per cent, and 22 occurred after delivery, with

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1. Alpers, B. J., and Palmer, H. D.: The Cerebral and Spinal Complications Occurring During Pregnancy and the Puerperium, J. Nerv. & Ment. Dis. **70**:465, 1929.

2. Roque, Fred: Epidemic Encephalitis in Association with Pregnancy, Labor and the Puerperium: A Review and Report of Twenty-One Cases, J. Obst. & Gynaec. Brit. Emp. **35**:1, 1928.

a mortality of 41 per cent. Of the 22 cases that occurred after delivery, 4 occurred within twenty-four hours, 5 within forty-eight hours, 1 within the third day, 1 within the fourth day, 8 within a month and the remaining 3 within four months after delivery. It is to be noted, however, that of the 21 cases reported by Roque, not one occurred after labor.

The mode in which latent lethargic encephalitis may be precipitated or rendered active by labor and the puerperium is illustrated in the case of Voron, Dechaume and Malarte.[3]

A primipara, aged 24, had a normal delivery except for the application of low forceps after nineteen hours of weak pains. At the end of labor, the patient had a fainting spell from which she rapidly rallied. Forty hours after delivery, she suddenly became unconscious and rigidity of the extremities with occasional athetoid movements developed. A series of convulsions then developed, and the patient died within twelve hours from gradually increasing respiratory embarrassment. Autopsy revealed that the brain was markedly swollen in the frontal section; the central gray matter and the subthalamic region appeared augmented in volume and hard in consistency, giving the impression of a gliomatous infiltration. Microscopically, these areas revealed a subacute inflammatory process characterized by the presence of lymphocytic infiltration about the vessels, by considerable increase in the neuroglial elements, by the presence of small discrete hemorrhages and by a marked edematous state of the substance of the brain. The picture was that of epidemic encephalitis, which pathologically antedated the onset of the symptoms by at least a number of days.

The author called attention to the fact that pregnancy and labor often render apparent certain conditions that are othewise unnoticed. He also called attention to the lack of expulsion pains in these cases. In the discussion, Cotte cited a case of pregnancy in a fibroid uterus in which radiographic study was followed by a rapidly fatal epidemic encephalitis.

REPORT OF CASE

History.—Mrs. Z. B., aged 23, whose family history was irrelevant and who was of neurotic nature but who had had no important illnesses or injuries, was delivered of a first child on April 1, 1927, with a version owing to a disproportion between the fetus and the pelvis. The last date of menstruation was Nov. 23, 1928. The present pregnancy had been normal throughout, excepting that the patient appeared somewhat anxious about the forthcoming labor. In the latter part of August, 1929, she had had a mild stomatitis involving the buccal mucosa and soft palate, which was treated by Dr. S. Coleman and was unaccompanied by fever or glandular enlargement.

The patient was admitted to St. Agnes Hospital on Sept. 3, 1929, on the service of Dr. Leonard Averett. On the same day she was given castor oil and quinine and, later in the evening, small doses of morphine. She was able to sleep the greater part of that night, and the following morning at 9, when the cervix was well dilated, she was delivered in twenty minutes of a normal infant. There

3. Voron; Dechaume and Malarte: Latent Epidemic Encephalitis Revealed During Labor, Bull. Soc. d'obst. et de gynéc. **16**:66, 1927.

were no lacerations requiring suturing, and the instrumentation, according to Dr. Averett, was simple; the customary light nitrous oxide anesthesia was employed. The baby appeared normal in color, but the mother failed to regain consciousness and remained somewhat cyanotic so that it was necessary to resort to oxygen and stimulation by alpha-lobeline for breathing. The color became gradually better, but she failed to regain consciousness.

When seen by me at 6:30 p. m. on the same day (Sept. 4, 1929), the patient appeared stuporous; she was perspiring profusely and had a fairly good color. The temperature was 99 F., the pulse rate 92, the respiratory rate, 18. The eyes were half open and rolled upward. She was unable to comprehend or carry out simple commands. At times she screamed without apparent cause. There was no rigidity of the neck or Kernig sign. The pupils were equal, dilated and responded to light; the fundi appeared normal, and there was no evidence of facial paralysis. She had no trouble in swallowing and took 12 ounces (340 Gm.) of orange juice and water within one hour in my presence. She was unable to speak and made an occasional indistinct nasal sound. There was no paralysis of the soft palate. There was no appreciable change in the tonus of the extremities. Stimulation by a pin prick resulted in a forceful movement, that revealed no evidence of paralysis; the biceps, triceps, knee and achilles reflexes were symmetrically exaggerated, but no Babanski or Hoffman sign was obtained. A catheterized specimen of urine showed a trace of albumin and occasional granular casts. The examination of the blood showed: sugar, 110 mg., and urea, 14 mg.

Course.—On Sept. 5, 1929, the temperature was 99.4 F., the pulse rate 82, and the respiratory rate, 24. The patient regained consciousness and was able to talk, but speech was somewhat thick. An examination of the other cranial nerves revealed no abnormalities. There was no evidence of meningeal irritation; the extremities showed no weakness; the reflexes and sensations were normal. The patient was emotional, crying and screaming without apparent cause. That night she required morphine to induce sleep.

On September 6, 7 and 8, the patient showed considerable improvement. The temperature continued to be about 99.3 F. in the evening and was normal in the morning; the pulse rate was 80, and the respiratory rate from 20 to 22. She was taking nourishment and felt stronger, but on September 6, she showed evidence of a retrograde amnesia; she stated that the baby had been born on the preceding day. She had no difficulty in swallowing, but speech remained thick; there was dragging out of the syllables with a singing tone. At intervals she cried and screamed without ascertainable cause. At night, she required barbital and phenobarbital to enable her to sleep.

A sudden change took place on September 9. During the afternoon of that day, the temperature rose to 100.6 F., the pulse rate to 100 and the respiratory rate to 24. She perspired profusely, was restless, tossed in bed and cried. Speech became thicker, and she had difficulty in swallowing. At this time a neurologic examination revealed weakness of the lower left side of the face and limitation of all extra-ocular movements. When seen later in the evening, the patient appeared worse and showed marked dehydration. The facial palsy was well marked, and she complained of being blind. That evening she received 1,000 cc. of saline solution by hypodermoclysis, and the continuous administration of 5 per cent dextrose by enteroclysis.

On September 10, the condition was unchanged, the temperature, pulse and respiratory ratio being the same. In addition to the previously noted difficulty with speech and swallowing and the left facial paralysis, there were massive movements of the extremities and occasionally finer choreiform movements of

the individual muscle groups. She was receiving nourishment and fluids by hypodermoclysis and enteroclysis.

On September 11, the patient was distinctly stuporous; she was aroused only with difficulty. The temperature was 99.2 F., the pulse rate 102 and the respiratory rate 24. She perspired less profusely. From time to time she tossed her limbs, especially the upper extremities; the movements were massive but occasionally finer choreiform movements were noticeable. The eyes were partly open; the eyeballs appeared immobile, and tests for extra-ocular movements were impossible. When the head, however, was turned passively to the right, the eyes turned to the left and vice versa. The pupils were equal and reacted well to light. An examination of the fundi showed no abnormalities. There was no weakness of the masseters and no corneal anesthesia. There was a slight weakness of the left lower part of the face but no weakness of the palate; the tongue protruded in the median line, but only for a slight distance. The lateral movements of the tongue were limited. Speech remained the same as on the previous day and there was serious difficulty in swallowing; there was no rigidity of the neck and no Kernig sign. The upper extremities were weak, presenting the aforementioned spontaneous movements, and exaggerated biceps and triceps reflexes, but no Hoffman sign. The lower extremities were also slightly weak and presented the already mentioned involuntary movements, but to a lesser extent. The knee and achilles reflexes were exaggerated, and there was no clonus or Babinski sign. Sensation, at least to pinpricks, seemed to be normal throughout. Dr. Spiller, who was called in consultation, regarded the condition as a circulatory disturbance of the brain, probably anoxemia and agreed that a lumbar puncture was contraindicated. A blood count on this date showed: erythrocytes, 4,640,000; hemoglobin, 89 per cent; leukocytes, 18,250; polymorphonuclears, 90 per cent; small lymphocytes, 10; eosinophils, 1 per cent. An examination of the urine gave negative results. Dr. George J. Kelly made the following report on the condition of the eyes: There was no proptosis; the palpebral fissures were equal. The pupils measured 4 mm.; they were equal and reacted to light. The ocular movements were apparently full, but the patient was not fully cooperative. The media were clear; the disks were of good color and outline; there were no changes in the fundi.

Pelvic examination showed that the perineum was in good condition; there were no lacerations; the cervix was slightly lacerated, the cul de sac, normal; the uterus was still somewhat enlarged and freely movable, and the tubes and ovaries were normal. There was no sense of rigidity anywhere. The patient continued to receive hypodermoclysis and enteroclysis and at the same time, with painstaking slowness, swallowed a mixture used for ordinary nasal feedings. Throughout this period she was constipated and required enemas; occasionally she had urinary incontinence. On the whole, the intake and output of fluid was satisfactory.

On September 12, she appeared slightly better, although the temperature rose to 100 F., the pulse rate to 114 and the respiratory rate to 24. Speech was more distinct, but swallowing was unimproved. In the afternoon, she was examined by Dr. Clerf who submitted the following report: There was a slight deviation of the nasal septum to the left with a small septal ridge. There was nothing abnormal about the mouth; the soft palate and fauceal pillars were normal with poor movements; the movements of the larynx were normal; both sides seemed to function equally well; the pyriform sinuses contained no excessive secretion; the sensation of the nose, mouth and pharynx seemed normal. In view of the patient's ability to swallow, Dr. Clerf suggested the continuation of feeding by mouth until it should be necessary to resort to feeding by tube.

Dr. Clerf was impressed with the fact that with all the difficulty in swallowing there was no coughing after swallowing, which would occur in any serious involve-

ment of the peripheral component. Roentgen examination of the sinuses and mastoids revealed no pathologic condition. The treatment was continued as before.

On September 13, the patient had seven hours of unbroken sleep and appeared decidedly improved. The temperature was 99.2 F., the pulse rate 98, and the respiratory rate 22. She turned the head freely in the direction of the examiner and promptly recognized him; she volunteered the information in a thick, hoarse voice that she felt much better; she swallowed more easily; fewer involuntary movements were noted.

During the following two days she showed a steady improvement; the temperature did not rise over 99 F.; the pulse rate did not exceed 98 and the respiratory rate, 22. She slept well without assistance and took 50 ounces (1,417 Gm.) of fluid by mouth in twenty-four hours. She was much clearer mentally; she now complained of weakness in the upper extremities. There was no headache. Involuntary movements were no longer noted.

From this time on, she showed rapid improvement. The temperature and pulse became normal within ten days (September 26). Following is a summary of a complete examination on Sept. 16, 1929:

Mentally, she was clear and well oriented; memory was good; she was attentive and carried out commands promptly. The sense of smell was normal on both sides; there was no impairment of vision and the fundi appeared normal. The pupils remained equal and regular and responded well to light and distance. The palpebral fissures were widely open; there was definite limitation of the extra-ocular movements, more particularly when looking to the left and on convergence. The upward movement was slight. The innervation of the upper part of the face was excellent and that of the lower part of the face fair—much better on emotional than on voluntary innervation. There was no impairment of hearing. Innervation of the palate was good. The voice was stronger and louder but speech resembled that in a fairly well advanced case of multiple sclerosis, that is, sing-song and scanning. She was unable to pronounce test words such as "truly rural" and "around the rugged rock." She protruded the tongue well and in the midline and was able to make side-to-side movements of the tongue without difficulty. There was definite weakness of both upper extremities, which was more pronounced at the wrists and fingers than at the elbow and shoulder. When told to lift both hands, there was a curious overpronation of both forearms with a dorsal flexion of both wrists and extension of the fingers. She was unable to touch her other fingers with the ball of the thumb and unable to make satisfactory fists; the dynamometer reading in both hands was under 10. Testing of individual groups of muscles showed weakness in all components. The biceps and triceps reflexes were active on both sides; there was no Hoffman sign. The senses of pain, of touch and of position were unimpaired, the finger-to-nose test was carried out with awkwardness, there being zigzagging before touching the tip of the nose. She was able to recognize objects put into the hands and could turn from side to side without much difficulty. The lower extremities also showed generalized weakness, but less in comparison with the upper extremities. The tendon reflexes were symmetrically increased, but there was no clonus or Babinski sign. There was no disturbance of the deep or superficial types of sensibility. The heel-to-knee tests were carried out satisfactorily.

On September 22, she continued to improve; speech was clearer, although still of the sing-song type. The extra-ocular movements had improved, enabling her to rotate the eyes upward and to the left fairly well, but she was still unable to converge properly. The power of the hands was increasing, especially on the right, but she was unable to form a satisfactory fist. She was unable to feed herself.

The pronation effect previously observed had disappeared and on performing the finger-to-nose test, there was a suggestion of an intention tremor, excepting that the movement was more massive than an ordinary intention tremor. There was increase in power of the trunk and lower extremities.

On September 27, she was distinctly improved. When she began to speak, speech was almost normal, but after a short while it reverted to the sing-song type. The extra-ocular movements were normal except for convergence. There was more strength in both hands and forearms and less intention tremor. She still showed clumsiness in the finer movements of the hands as well as in the pronation-supination test. She sat up, swinging her feet out of bed.

On September 29, the condition was generally good. She was able to sit up out of bed; all of the extra-ocular movements were good with the possible exception of convergence; she still had a tremor when carrying out the finger-to-nose test, especially on the left side. The tremor was more pronounced when she was tired, so that, according to the nurse, on beginning a meal she handled the utensils well, but by the end of the meal the tremor became apparent. Speech was improved, although it was still sing-song.

On October 10, the improvement was marked. Convergence was almost perfect. The nurse stated that the patient had a tendency to hold her head down. Speech was improved; the finger-to-nose test was performed well on the right, but on the left there was a distinct tremor. The pronation-supination test was well done. The power in both upper extremities was good. There was no change in reflex activity. The patient made an attempt at walking and complained that her legs "kick out." She walked like a spastic patient. The achilles and knee reflexes were markedly increased. There was no Babinski sign. The knee-to-heel test presented a distinct intention tremor. Mentality was clear, and she was discharged from the hospital on Oct. 15, 1929.

On returning home she made a slow, steady improvement. Following is a summary of an examination on Jan. 13, 1930: She perspired profusely; she appeared unable to sleep sufficiently, became drowsy during the day and felt tired on rising in the morning. The fatigability interfered with the performance of the usual household work. Occasionally, vision became impaired, especially on entering a house from without. Sometimes, while sitting still the head twisted. She was unable to descend steps without the support of the banister and ascribed this to weakness and stiffness of the left leg. She stated that the left hand shook when she was tired or after exertion.

Objective examination showed that the patient was mentally clear, with a staring expression of the face. There was imperfect convergence. Considerable improvement had occurred in speech which, however, was still thick, monotonous and slow. There was slight spasticity in walking, which was more marked on the left side; there was an increase in the knee and achilles reflexes on the left as compared with the right.

Reexamination in June, 1930, revealed, in addition to the facts reported for the last examination, that there was a slight pallor of the temporal side of the right fundus, less so on the left, a shotlike myoclonic movement of the tip of the protruded tongue, a slight lessening of the swinging movements of walking and myoclonic movements of the fingers of the extended left hand.

On July 31, 1930, reexamination showed that the patient complained of dizziness, especially on stooping or any other rapid change in position. She stated that things grew dark before the eyes and that it took some moments to collect herself. Physical examination showed that the condition remained unchanged. (The child had shown no abnormalities since birth and was thriving well.)

Summary.—Immediately after an instrumental labor, a previously healthy woman presented an acute and diffuse involvement of many regions of the brain. Particularly striking was the involvement of the supranuclear structures concerned with articulation and swallowing, disturbances of consciousness, transient blindness, general increased tonus in the musculature with increased reflexes, myoclonic movements of the extremities and transient weakness of the extra-ocular muscles. These phenomena were accompanied by a febrile course and a serious constitutional reaction, but with no evidence of meningitis. There followed a rapid recession of the symptoms with residues pointing to a slight but permanent damage to the extrapyramidal system.

Comment.—In the absence of meningitis, the sudden and diffuse implication of many regions of the brain aroused suspicions of considerable cerebral edema, irrespective of any other changes that may have taken place. This, in the presence of alarming bulbar symptoms, restrained us from the temptation of spinal tapping. It is believed that in cases of this sort—and this was also the opinion of Dr. Spiller—spinal drainage may be disastrous. Dehydrating the brain by restricting the intake of fluids and the intravenous administration of 50 per cent dextrose, as successfully practiced in a recent case of acute epidemic encephalitis, is by far a better procedure. Rapid recession of the symptoms and the almost complete restitution of functions supported the idea that the preponderance of tissue changes might have been edematous.

The clinical symptoms indicated the implication of both the gray and white substances, but more of the latter. As in all cases of encephalitis, the brunt of the injury was sustained by the motor system. The pyramidal system was severely affected in the supranuclear bulbar components and to a lesser extent in other areas and yet made a good functional recovery. This case demonstrated the interesting Gielich pronation phenomenon,[4] in which the patient is unable to supinate the hand to a normal degree. As Gielich pointed out, the pronation phenomenon is normal in the first months of life, and, phylogenetically, supination of the hand is complete only in the higher animals and in man. The last half of supination of the hand is dependent on the integrity of the pyramidal tracts and is lost by a slight disturbance of the latter. In this case, the extrapyramidal system did not recover completely.

Regarding the diagnosis in this case, especially with reference to etiology and anatomic changes, no positive statements can be made. The mode of onset and the clinical course ruled out fairly certainly a diagnosis of epidemic encephalitis. Yet the entire progress of the case,

4. Gielich: Deutsche Ztschr. f. Nervenh. **84**:38, 1925.

and especially the mode of termination, bespoke some acute process that would fit well in the clinical picture of an encephalitis of some sort. A review of the literature of nonsuppurative, nonepidemic encephalitis disclosed the fact that there exists a great deal of confusion relative to the term "encephalitis," and it appeared worth while to summarize briefly the observations with an attempt at orientation for clinical purposes.

AN ATTEMPT AT ORIENTATION IN NONSUPPURATIVE, NONEPIDEMIC TYPES OF ENCEPHALITIS

The term "encephalitis" or "cerebritis," as used clinically, implies an inflammatory condition of the brain and includes many clinical syndromes with a variety of etiologic factors. In many of these cases a pathologic study discloses an absence of inflammation that renders the clinical diagnosis of encephalitis untenable. It is the difference in these two points of view, the pathologic on the one hand and the clinical on the other, that is the cause of the confusion. A brief comparison of them may be of interest.

Pathologic Conceptions of Encephalitis; Inflammation and Degeneration and their Relation to Etiology.—From a pathologic point of view, the term encephalitis can be applied only to conditions in which there is "inflammation." According to MacCallum,[5] inflammation is a complicated vascular and cellular response, which follows an injury; and which by bringing much blood to the spot and pouring out its elements on the injured tissues, prevents the extension of the injury and holds in check the injurious agent or even destroys it. Through the agency of some of the cells that are brought in, and in other purely mechanical ways, inflammation is also important in clearing away the débris of injured or dead tissue and preparing the way for the process of repair. Inflammation is a defense reaction and has for its purpose the removal of an irritant that may be physical, chemical or bacterial; inflammation is a "process" and not a "state," as was pointed out by Burdon-Sanderson.[6] The process of inflammation as applied to the nervous system, is confined to conditions in which, on histologic investigation, there are exudative, infiltrative and proliferative changes in the mesodermal tissues and alterative changes in the parenchymatous cells (Spielmeyer[7] and Jakob[8]). From a neuropathologic standpoint, the criterion of

5. MacCallum, W. G.: A Text Book of Pathology, Philadelphia, W. B. Saunders Company, 1916, p. 133.

6. Burdon-Sanderson, quoted by Adami in Allbutt and Rolleston: System of Medicine, New York, The Macmillan Company, 1907.

7. Spielmeyer, W.: Histopathologie des Nervensystems, Berlin, Julius Springer, 1922.

8. Jakob, A.: Anatomie und Histologie des Grosshirns, Vienna, Franz Deuticke, 1927, vol. 1, p. 417.

inflammation is purely microscopic and rests on predominantly mesodermal changes in which a variety of mobile and fixed cells participate. The mobile cells consist of leukocytes, lymphocytes, plasma cells and histiocytes. The fixed cells concerned in the inflammatory processes in the central nervous system are the fibroblasts and proliferative glia cells; their function is repair and scar formation. The alterative changes in neuropathology correspond somewhat to the cloudy swelling observed in general pathologic conditions. Inflammation may be suppurative or nonsuppurative, focal or diffuse, acute or chronic. The end-results of inflammation may be restitution ad integrum, liquefaction and the production of scar tissue. The end-results of inflammation in the central nervous system may show no evidences of inflammation, as is seen also in the kidneys in advanced Bright's disease.

A widely accepted concept of the encephalitides is that devised by Pette,[9] which divides these diseases into two main groups: (1) acute inflammatory diseases affecting mainly the gray matter, such as poliomyelitis, epidemic encephalitis, rabies, herpes zoster and herpetic encephalitis; (2) acute inflammatory diseases affecting chiefly the white matter such as the various forms of disseminated encephalomyelitis that have the common feature of attacking the myelin sheaths, particularly the pyramidal system. The symptoms may come on acutely and result in death; or subsidence of symptoms with restitutio ad integrum may follow. In this group are included encephalitides associated with vaccinia, measles and other infections, as well as acute multiple sclerosis and acute diffuse sclerosis. The causes are both toxic and infectious.

From a neuropathologic standpoint, inflammatory conditions of the brain are to be sharply differentiated from degenerative processes. The latter, like inflammation, also result from a variety of toxic and infectious causes. Degeneration consists of changes in the ganglion cells and nerve fibers with important secondary changes in the glial elements and without any appreciable reaction on the part of the vascular and mesodermal apparatuses that play the all important rôle in inflammations. Degenerations may be primary or secondary. The primary are exemplified by change in the gray matter in progressive spinal muscular atrophy and in the white matter by the posterolateral sclerosis of pernicious anemia. The secondary degenerations may follow injury, as is seen in wallerian degeneration and in vascular obstruction, as in cerebral thromboses with hemiplegia, and they may follow inflammatory processes. Degeneration is commonly divided into two stages: (1) the falling out of the parenchymatous elements, that is, the more or less destructive changes in the ganglion cells and the demyelinization of the nerve fibers and (2) the removal of various waste products,

9. Pette: Zentralbl. f. d. ges. Neurol. u. Psychiat, **54**:112 (Oct.) 1929.

mostly lipoids, by the glial elements and the replacement of the atrophied structures by the glia fibers. The end-results of degeneration are less favorable from a functional standpoint, often leading to more or less complete structural changes.

It is important to bear in mind that the conceptions "inflammations" and "degenerations" are purely micropathologic ones and that they do not have specific relation to etiologic factors. The pathologic responses evoked by different etiologic agents are so similar in all respects as to indicate that the reaction of the nervous system to these agents is nonspecific. This is illustrated by a markedly similar type of encephalitis evoked by such different clinical diseases as epidemic encephalitis, poliomyelitis, rabies and probably herpetic encephalitis In fact, the same etiologic factors, toxic or infectious, are capable, depending on the intensity and duration of the agent, of producing either inflammatory or degenerative changes or both. This is particularly true of dementia paralytica in which there is no longer any question of the etiologic factor, and in which there are found side by side both inflammatory and degenerative changes (Spielmeyer [7]). The association of both inflammatory and degenerative changes was also found in epidemic encephalitis by Creutzfeld [10] and in typhus fever by Spielmeyer.[7]

The actual pathologic responses seen in these inflammatory and degenerative conditions are not only not pathognomonic of any specific etiologic factors, but they do not clearly indicate the clinical syndrome that produced them. This also is well illustrated by a review of the available literature on the clinicopathologic studies in encephalitis to which attention will now be directed. To limit discussion, suppurative and epidemic encephalitis and also tuberculous and syphilitic changes in the brain will be omitted. It is deemed advisable to consider the subject in more or less chronologic order, so that it will be observed how the clinical conception of encephalitis becomes modified by neuropathologic investigations.

Clinicopathologic Conceptions of Nonsuppurative, Nonepidemic Encephalitis; Relation of this Type of Encephalitis to Pathologic Conceptions of Inflammation and Degeneration.—Before the appearance of epidemic encephalitis in 1919, encephalitis as a clinical entity received little attention in the literature. In 1884, Strümpell [11] described a case of encephalitis, usually with hemiplegia, with pathologic changes similar to those in anterior poliomyelitis. Later, it was disclosed that, like

10. Creutzfeld: Encephalitis Epidemica, Ztschr. f. d. ges. Neurol. & Psychiat. **24**:23, 1921.

11. Strümpell, A.: Ueber der akute Encephalitis der Kinder, Jahrb. f. Kinderh. **22**:173, 1885.

Wernicke's [12] external ophthalmoplegia, Strümpell's encephalitis may be caused by a true polio-encephalitis, by sudden vascular lesions or by hemorrhagic encephalitis as a sequel to influenza. In 1895 and again in 1897,[13] Putnam [14] reported a number of cases, mostly following infectious diseases, in which he found pathologically petechial hemorrhages, ganglion cell and axonal destruction and perivascular infiltration with round cells, leukocytes and plasma cells; the brains were soft and friable, with small foci of hemorrhagic softening. Similar hemorrhagic types of encephalitis were described by Oppenheim [15] and Abt.[16] Marx [17] described a case of encephalitis with extensive necrosis, atrophy of white matter, disappearance of the ganglion cells and marked proliferation of the neuroglial tissue. A review of the literature prior to epidemic encephalitis reveals that a variety of pathologic conditions, including ones that are purely inflammatory, degenerative or vascular or a mixture of two or more of these conditions, have been described clinically as encephalitis.

Since the epidemic of influenza in 1918, a series of interesting contributions have been made. Under the term "acute serous encephalitis, as a clinical entity," Anderson, [18] and later Brown and Symmers [19] described a rapidly fatal disease in children with a rapid onset, hyperemia, vomiting, diarrhea, irritability, delirium ptosis, nystagmus, hemiplegia, convulsions and coma. In these cases the pathologic changes were an extreme degree of engorgement of the pia-arachnoid and flattening of the convolutions with obliteration of the sulci. Microscopically, the most constant changes were hyperemia and edema of the pia-arachnoid, engorgement of the blood vessels of the brain, perivascular and pericellular edema, with and without vascularization of the ground substance and acute cloudy swelling of the pyramidal cells. Hemorrhages were rare. The most striking observations were that nearly every blood vessel was surrounded by an apparently empty space,

12. Wernicke, Carl: Lehrbuch des Gehirnkrankheiten, Berlin, 1881.

13. Putnam, J. J.: A Contribution to the Clinical History of Non-Suppurative, Acute (Hemorrhagic) Encephalitis with Report of a Case Following Mumps, J. Nerv. & Ment. Dis. **22**:1, 1897.

14. Putnam, J. J.: The Relation of Infectious Processes to Diseases of the Nervous System, Am. J. M. Sc. **109**:254, 1895.

15. Oppenheim: Lehrbuch der Nervenkrankheiten für Aerzte und Studierende, Berlin, S. Karger, 1923.

16. Abt, I. A.: Acute Nonsuppurative Encephalitis in Children, J. A. M. A. **47**:1184 (Oct. 13) 1906.

17. Marx, N. P.: Four Cases of Acute Nonsuppurative Encephalitis in Children, Brit. J. Child. Dis. **7**:241, 1910.

18. Anderson, A. Y.: Report of Five Cases of Acute Encephalitis, Boston M. & S. J. **189**:177, 1923.

19. Brown, C. L., and Symmers, D.: Acute Serous Encephalitis, Am. J. Dis. Child. **29**:174 (Feb.) 1925.

corresponding to an area of edema. The authors regarded the disease as infectious and called it "acute serous encephalitis." In this case the term encephalitis is justified by the purely exudative nature of the process. A somewhat more complicated picture is presented by the work of Grinker and Stone,[20] who studied thirteen cases of acute cerebral involvement in children associated with or following a variety of infections both of a local purulent character and of a generalized character. Clinically, these cases were characterized by rapidly developing symptoms of diffuse cerebral involvement, often associated with meningeal symptoms, early stupor, hyperpyrexia and death within three or four days. The spinal fluid was usually entirely normal. The authors termed this disease "acute toxic encephalitis," though pathologically they found a condition in which there was a noticeable absence of infiltration with mesodermal elements. In all cases studied there was destruction of the ganglion cells and obliteration of the lumen of many capillaries, and in some cases, the formation of new vessels. They closely resembled the encephalopathies described in lead, arsenic and other intoxications. These observations are regarded as a response to a bacterial toxin rather than to a microbic invasion which is seen in actual invasions of the substance of the brain by a virus such as is found in poliencephalitis or in epidemic encephalitis. In the latter, the mesodermal infiltration and hemorrhagic phenomena are distinctly in evidence. Low [21] distinguished two types of encephalitis in children, one with peracute liquefaction and predominantly regressive glial changes, especially in the cortex, and another with acute liquefaction and predominantly progressive glial changes. The peracuteness of the process is determined by the degree of the toxicity. The ectodermal elements are primarily and preeminently affected, there being no perivascular infiltration; there are only a slight hypertrophy of the endothelial cells and a hyperplasia of the adventitial cells. It is interesting to note that Grinker and Stone emphasized the relative poverty of "inflammatory" reaction in these infectious conditions. In the cases described by Grinker and Stone and Low, which followed acute infectious processes, there is already noticeable a tendency to call a disease encephalitis in which there is a predominance of degenerative and vascular processes rather than purely inflammatory conditions.

The almost total absence of true inflammatory changes in serious cerebral conditions that may follow a variety of infections and toxemias,

20. Grinker, R. R., and Stone, T. T.: Acute Toxic Encephalitis in Childhood: A Clinicopathologic Study of Thirteen Cases, Arch. Neurol. & Psychiat. **20**: 244 (Aug.) 1928.

21. Low, A. A.: Acute Toxic (Nonsuppurative) Encephalitis in Children: A Study of Five Cases, Arch. Neurol. & Psychiat. **23**:696 (April) 1930.

was further stressed by Winkelman and Eckel.[22] These authors described changes in the brain in seven cases, including typhoid fever, acute rheumatic fever, toxemia of pregnancy, erysipelas, Hodgkin's disease, chronic tuberculosis and an undetermined toxic condition. In these cases the clinical picture consisted of delirium, muscle twitchings, convulsions, hallucinosis and evidences of meningeal irritation. Pathologically, they found proliferative and obliterative changes in the small blood vessels leading to local ischemia, changes in the ganglion cells and eventually cortical softening. Nissl[23] and Alzheimer[24] noted similar vascular changes in syphilis and metallic poisoning.

A similar absence of inflammatory changes is seen in the so-called hemorrhagic encephalitis first described by Rosenfeld.[25] This was stressed by Schmidt,[26] Oeller[27] and more recently by Alpers,[28] who reviewed ten cases, which included bronchopneumonia, rheumatic fever, secondary anemia, primary aplastic anemia, acute nephritis, endocarditis, cerebral thrombosis, chronic nephritis, meningovascular syphilis and arteriosclerosis. The foci are pinpoint discolorations scattered through the white matter that often appear like purpuric spots; they occur almost exclusively in the white matter. They also occur in all sorts of toxic conditions (carbon monoxide, phosgene gas, arsphenamine), trauma and a variety of infections, in the anemias and in the circulatory disturbances of the brain. Microscopically, in the center of these foci there is a capillary, the endothelium of which is swollen or completely destroyed. Immediately around the vessel there is an area of necrotic tissue of variable size; in this area there are occasionally a few cells. Beyond the necrotic area is a "palisade-like" arrangement of glia cells (Spielmeyer). Beyond the collar of the glia cells there may or may not be hemorrhages. The term "hemorrhagic" is largely a misnomer. I stress the fact that the process is not inflammatory; it is largely perivascular, and it is in the white matter. According to Spiel-

22. Winkelman, N. W., and Eckel, J. L.: Endarteritis of the Small Cortical Vessels in Severe Cases of Various Infections and Toxemias, Arch. Neurol. & Psychiat. **21**:863 (April) 1929.

23. Nissl, Franz: Zur Histopathologie der paralytischen Rindenerkrankungen, Histopathologischen Arbeiten, Jena, Gustav Fisher, 1904, vol. 1.

24. Alzheimer, A.: Progressiv Paralyse und endarteritisch Hirnlues, Zentralbl. f. Nervenh. u. Psychiat. **16**:443, 1905.

25. Rosenfeld, M.: Zur Casuistic der akuten hemorrhagischen Encephalitis, Deutsche Ztschr. f. Nervenh. **24**:415, 1903.

26. Schmidt, M. B.: Ueber Gehirn Purpura und hemorrhagischen Encephalitis, Beitr. z. path. Anat. u. z. allg. Path. (supp.) **7**:419, 1905.

27. Oeller, H.: Pathologisch-anatomisch Studien zur Frage der Entstehung und Heilung von Hirnblutungen und über ihre Stellung zur hemorrhagischen Encephalitis, Deutsche Ztschr. f. Nervenh. **47**:504, 1913.

28. Alpers, B. J.: "Brain Purpura" or "Hemorrhagic Encephalitis," Arch. Neurol. & Psychiat. **20**:497 (Sept.) 1928.

meyer,[7] the term "hemorrhagic encephalitis" should be limited to those infections that produce evidence of an inflammatory reaction with rupture of blood vessels. This is seen after influenza and after scarlet fever as in the case reported by Toomey, Dembo and McConnell.[29]

A fairly happy agreement seems to exist that a true encephalitis may follow measles (Greenfield[30]), variola (Wilson and Ford[31]), vaccination for cowpox (Turnbull and McIntosh,[32] Perdrau,[33] Coyle and Hurst[34] and Hassin and Geiger[35]) and human rabies and vaccination for rabies (Bassoe and Grinker[36]). In these encephalitides the principal changes were perivascular infiltrations of round cells with demyelination and often destruction of axis cylinders, a toxic reaction in the ganglion cells, vascular endothelium and oligodendroglia. The processes affect principally the white matter, and the most characteristic change is demyelination. Some of the other diffuse and often destructive diseases of the white matter with demyelination, such as acute multiple sclerosis and disseminated encephalomyelitis, are regarded by some as being of inflammatory nature (Bouman and Bok[37] and Hallervorden[38]), while Schilder's disease and allied conditions, according to Globus and Strauss,[39] are considered as noninflammatory. The changes produced by exogenous poisons, such as lead and arsenic, have been alluded to and are admirably described by Hassin.[40]

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29. Toomey, J. A.; Dembo, L. H., and McConnell, G.: Acute Hemorrhagic Encephalitis: Report of a Case Following Scarlet Fever, Am. J. Dis. Child. **25**: 98 (Feb.) 1923.

30. Greenfield, J. G.: Brain **52**:171 (July) 1929.

31. Wilson, R. E., and Ford, F. R.: The Nervous Complications of Variola, Vaccinia and Varicella, Bull. Johns Hopkins Hosp. **40**:337, 1927.

32. Turnbull, H., and McIntosh, J.: Encephalomyelitis Following Vaccination, Brit. J. Exper. Path. **7**:181, 1926.

33. Perdrau, J. R.: The Histology of Post Vaccinal Encephalitis, J. Path. & Bact. **31**:17, 1928.

34. Coyle, D. C., and Hurst, E. W.: Lancet **2**:1246, 1929.

35. Hassin, G. B., and Geiger, F. C.: Postvaccinal (Cowpox) Encephalitis: A Clinicopathologic Study of a Case, Arch. Neurol. & Psychiat. **23**:481 (March) 1930.

36. Bassoe, P., and Grinker, R.: Human Rabies and Rabies Vaccine Encephalomyelitis: A Clinicopathologic Study, Arch. Neurol. & Psychiat. **23**: 1138 (June) 1930.

37. Bouman, L., and Bok, S. T.: Ztschr. f. d. ges. Neurol. u. Psychiat. **111**: 495, 1927.

38. Hallervorden: Zentralbl. f. d. ges. Neurol. u. Psychiat. **54**:132 (Oct.) 1929.

39. Globus, J. H., and Strauss, I.: Progressive Degenerative Subcortical Encephalopathy (Schilder's Disease), Arch. Neurol. & Psychiat. **20**:1190 (Dec.) 1928.

40. Hassin, G. B.: The Contrast Between the Brain Lesions Produced by Lead and Other Inorganic Poisons and Those Caused by Epidemic Encephalitis, Arch. Neurol. & Psychiat. **6**:268 (Sept.) 1921.

Correlation of the Clinical Designation of "Encephalitis" with Etiologic Factors and Pathologic Observations.—A review of the literature reveals that on invading the central nervous system many toxic and infectious processes produce mental and neurologic symptoms and signs that are designated clinically as encephalitis. Some of these etiologic agents, as revealed by pathologic studies, produce purely inflammatory changes. These changes include epidemic encephalitis, the encephalitis following measles, smallpox, rabies, vaccination for cowpox and rabies, poliencephalitis disseminata, etc. These cases are correctly termed encephalitis. Other etiologic agents produce degenerative and obstructive vascular changes, as the cases described by Winkelman and Eckel,[22] Alpers [28] and others; in these cases an "itis" is not correct from the pathologic standpoint. Moreover, the same causative factors that produce a clinical encephalitis produce pathologically both inflammatory and degenerative changes, as in the cases described by Grinker and Stone [20] and others.

A correlation between etiologic, clinical and pathologic conceptions in so-called encephalitis seems almost impossible at the present time. The neuropathologist experiences little difficulty in classifying the end-results of a variety of diseases at necropsy examination. From a pathologic standpoint, one can make a correct diagnosis as to whether a given case is encephalitis, degenerative disease or a purely vascular process. The clinician, too, is justified in designating certain cases such as those following measles, vaccination, etc., as encephalitis. But many conditions that are associated with toxic and infectious processes, often termed encephalitis, are really not inflammations. The situation in this respect is much like that of the nephritides. The term nephritis, an inflammatory condition of the kidney, has long been recognized as a misnomer by pathologists. It is often purely a degenerative condition, and the correct pathologic designation of nephrosis (Müller [41]) has been introduced to apply to degenerative states of the kidney. This pathologic innovation proved of little help to the internist, as was shown in a critical review by Christian.[42] In his conclusions, among other remarks, Christian stated: "If it is helpful to the pathologist to use nephrosis for degenerative lesions, as suggested by Müller, obviously there can be no objection; only as clinicians I think that we should recognize that we may be unable during life to predict accurately whether the pathologist is going to find more or less nephrosis or less or more nephritis; in other words, we are still in the same predicament in which we have always been, unable to use a pathologic classification of nephritis that

41. Müller, Frederick: Morbus Brightü, Verhandl. d. deutsch. path. Gesellsch. (Meran, 1905), Jena, Gustav Fisher, 1906, pp. 64-98.

42. Christian, Henry A.: Nephrosis: A Critique, J. A. M. A. **93**:23 (July 6) 1929.

can be applied accurately and easily in the clinic." It is precisely this inability to predict during life—in the clinical course of a case—whether one is dealing with an encephalitis or a degenerative process that makes an accurate classification of "encephalitis" so difficult. For this reason, it is doubtful whether the term "encephalosis," proposed by Winkelman [43] to designate degenerative conditions of the brain, is going to be of help to the bedside neurologist. For the time being at least, from a clinical standpoint, greater stress must be laid on the etiologic and clinical aspects of cases of invasion of the central nervous system with corresponding therapeutic efforts in this direction; at the same time the variable gross and micropathologic conditions produced by the same cause or causes should be borne in mind. The importance of an etiologic approach in the study of brain complications is forcibly brought out by an editorial in the *Journal of the American Medical Association*.[44] Owing to the increased frequency of so-called encephalitis following a host of infectious diseases, certain inoculative procedures and certain toxic states of both endogenous and exogenous origin, the problem is becoming of great importance to the practicing physician. A purely pathologic orientation and classification for clinical purposes appears impossible for the present. At all times an etiologic approach is helpful in every branch of medical practice.

NONSUPPURATIVE, NONEPIDEMIC ENCEPHALITIS OCCURRING AFTER LABOR AND DURING THE PUERPERIUM

As stated in the introduction, encephalitis commencing after labor or in the puerperium is rare. Roque [2] collected twenty-two cases of epidemic encephalitis, and Lieb [45] collected eight cases of "toxic" encephalitis. With the etiologic approach in mind, encephalitis occurring after labor and in the puerperium should be traceable to: (*a*) some causative toxic factor produced by pregnancy, (*b*) some latent infection that becomes activated by labor or the puerperium or (*c*) to some other conditions associated with the process of labor or the puerperium.

(*a*) Whether pregnancy is capable of producing a toxic state that may result in encephalitis is a mooted question. Roque [2] collected twenty-two cases of epidemic encephalitis that commenced after labor or in the puerperium. He concluded that pregnancy does not increase susceptibility to epidemic encephalitis and that the incidence of the

43. Winkelman, N. W.: Toxic Encephalitis in the Acute Infections of Childhood, Pennsylvania M. J. **33**:208 (Jan.) 1930.

44. Postinfectious Encephalitis: A Problem of Increasing Importance, Editorial, J. A. M. A. **92**:1523 (May 4) 1929.

45. Lieb, H. A.: A Case of Encephalitis Occurring in the Puerperium: A Contribution to the Problem of Pregnancy Toxicosa, Schweiz. med. Wchnschr. **54**:550, 1924.

latter disease is not greater among pregnant than among nonpregnant women of the same age. On the other hand, from a critical study of fourteen cases of toxic encephalitis complicating pregnancy and the puerperium, Lieb,[45] concluded that pregnancy produces a toxic condition that is capable of producing encephalitis and myelitis. Of the fourteen cases, eight became manifest only during the puerperium; here again Lieb called attention to the fact that the same is true of puerperal myelitis. According to this author, it appears that pregnancy produces a toxic state that often becomes effective only after the product of conception is expelled. He compared this with diphtheritic paralysis which makes its appearance after the disease has run its acute clinical course.

Lieb cited the case of a woman, aged 31, with a normal pregnancy, who was delivered normally on July 2, 1923. On July 12, on attempting to arise from bed, she became nauseated and vomited. She returned to bed and felt well for the next two days. Only July 14, when she again attempted to arise, she felt weak and had to remain in bed. At noon, she was unable to recognize her husband; she was apathetic and did not speak. The temperature was 37.2 C. (98.9 F.), the pulse rate 78. There was incontinence of urine, but no vomiting. On July 15, the temperature was 38.6 C. (101.4 F.), the pulse rate 84. The patient was motionless, did not respond when spoken to, but followed objects around the room with her eyes; however, she did not move the eyes in order to do so. The facial expression was staring and contrasted strikingly with the lively movements of the eyes. The mouth remained open, and there was acetone in the breath. The arms were spastic, with flexion at the elbows, and clonic movements were seen now and then. There was distinct catalepsy, with slow deep breathing and incontinence of feces and urine. The lower extremities showed a slight paralysis; the patellar and achilles reflexes were depressed; the Babinski sign was negative on both sides; there was a positive Oppenheim sign on the left. The urine was normal. On July 16, the pulse became rapid and weak; the patient became livid and was stimulated by camphor, caffeine, etc. That evening she had difficulty in swallowing, and mumbled words in a toneless way; she was fed by tube. On July 17 the condition was unchanged; the temperature was 39.2 C. (102.5 F.). On July 18, the eyes were staring and fixed on the ceiling; she showed no interest in the surroundings; there were a rigid neck, a positive Kernig sign, Cheyne-Stokes breathing, and a temperature of 39.6 C. (103.5 F.). Lumbar puncture showed increased pressure, and clear fluid with no cells. Death followed. The autopsy revealed that the dura was tense; the longitudinal sinus was filled with blood; the dura was adherent to the pia in the posterior third; the pia was bloody anteriorly, and stripped freely from the substance of the brain. In the region of the right centrum ovale there were two fresh hemorrhages, measuring 1 and 2 cm., respectively, in diameter. In the region of both thalami, there were two symmetrical gray-red, soft foci, about 2 cm. in diameter, surrounded by areas of punctiform hemorrhages. In close proximity there were also numerous perivascular hemorrhages. Microscopically, there were many small hemorrhages and dilated blood vessels with and without thrombosis. The thrombosed material, as well as the perivascular spaces, and especially the small vessels, showed numerous polymorphonuclear leukocytes.

The microscopic diagnosis in Lieb's case was toxic puerperal encephalitis. The same appearance may be noted in cases of grip (influenza). In this case, there was no evidence of influenza in the patient or in the neighborhood. The uterus showed dilated blood vessels with considerable thrombosis, with thickening and hyaline degeneration of the walls.

The contention that pregnancy in itself, apart from coexisting infection, is capable of producing an encephalitis receives little support. The extreme infrequency of encephalitis is in itself a good argument. Chorea gravidarum, which is generally regarded as a nonepidemic type of encephalitis (Lehoczky-Semmelweis[46] and Siemerling[47]), is generally regarded as infectious in origin, closely allied to Sydenham's chorea and activated by the emotional and physiologicopathologic strain of pregnancy.[48] Chorea occurs rarely during the puerperium, as in the case of Lhermitte and Cornil.[49] That toxemias of pregnancy, especially nephritis and uremia, cause vascular changes, hemorrhages of variable size, cerebral edema with a variety of neurologic manifestations both antepartum and postpartum, has long been known (Gowers[50]).

(*b*) While the various processes and changes incident to pregnancy may not in themselves be the cause of encephalitis, there is no reason why they should not harbor, conceal or mask a latent infection that may become activated after labor. A case in point is reported by Bauch.[51]

In a previously healthy primipara, aged 24, an attack of grip with diffuse bronchitis developed in the sixth month of pregnancy from which she seemingly recovered in about two weeks. Eight days after normal labor, three months later, evidence of bulbar paralysis gradually developed, with difficulty in swallowing and talking and later extra-ocular palsies and excessive salivation. She died on the sixteenth day of the puerperium from respiratory failure. In addition to hyperemia of internal organs, the necropsy examination revealed perivascular infiltration, minute hemorrhages and considerable edema in the midbrain, medulla and cervical cord.

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46. v. Lehoczky-Semmelweis: Ein Fall von Chorea gravidarum mit histologischen Befund, Zentralbl. f. Gynäk. **50**:608 (March 6) 1926.

47. Siemerling, E.: Nervöse und psychische Störungen während Schwangeschaft, in Doderlein, Albert: Handbuch der Geburtshilfe, Munich, J. F. Bergmann, 1916, vol. 2, p. 467.

48. Winkelman, N. W.: Ueber einen Fall für fünf Monate bestehenden Schwangerschaft Chorea mit anatomischen Befunde, Ztschr. f. d. ges. Neurol. & Psychiat. **102**:56, 1926.

49. Lhermitte and Cornil, quoted by Kehrer, F.: Erblichkeit und Nervenleiden, Berlin, Julius Springer, 1928.

50. Gowers, William R.: A Manual of Diseases of the Nervous System, Philadelphia, P. Blakiston's Son & Company, 1888.

51. Bauch, B.: Zentralbl. f. Gynäk. **42**:861, 1919.

In this case, the likelihood of a latent infection can hardly be questioned. Focal infections may possibly play a part in the production of encephalitis following the effect of labor.

(*c*) The stress and strain and the rapid bodily changes that occur during and shortly after labor received little attention in their relation to the central nervous system. The increased muscular effort, the augmented cardiac action with rise in the arterial tension have been recognized as causes of cerebral and spinal hemorrhages in the puerperium in normal (non-instrumental) cases. In more recent years, the widespread use of anesthetics has probably contributed an additional factor to be reckoned with. Nitrous oxide-oxygen is the most common anesthetic employed. Unless this anesthetic is administered by a skilled and careful anesthetist, evidence of asphyxia is apt to develop. Death in nitrous oxide anesthesia is usually due to asphyxia. A search of the literature of cases in which an autopsy was done revealed many pathologic conditions in the lungs and other viscera, but practically no microscopic changes in the central nervous system. In most of the cases no mention was made of an examination of the brain or cord. Yet the effect of asphyxia, even temporary asphyxia, on the cells of the brain is extremely important, as was clearly demonstrated by Gildea and Cobb.[52] From their experimental works on cats, these investigators drew the following valuable conclusions: Anemia (anoxemia and asphyxia) of not more than ten minutes results in permanent injury to the cortex and brain stem and not uncommonly in changes that end in death from convulsions or failure of the respiratory center. If the anoxemia is less complete or of briefer duration and the animals survive, there result demonstrable microscopic changes in the cortex and the brain stem consisting of areas of necrosis and in shrinking and chromatalysis of the cortical cells. Gildea and Cobb further stated that cerebral anemia is common in many industrial accidents such as electric shock and carbon monoxide poisoning, and perhaps in many medical conditions. Bodechtal [53] stressed the sensitiveness of the brain to anoxemia. He reported a case in which in the beginning of a rectal operation there was a cessation of the action of the heart for from ten to fifteen minutes. The patient was resuscitated by subdiaphragmatic cardiac massage, but died in fifteen hours after several convulsions. Necropsy revealed infiltration of the pia by lymphocytes, vascular engorgement and occasional small hemorrhages in the cortex and cellular changes that were very much like those described by Gildea

52. Gildea, E. F., and Cobb, S.: The Effects of Anemia on the Cerebral Cortex of the Cat, Arch. Neurol. & Psychiat. **23**:876 (May) 1930.

53. Bodechtel, G.: Befunde am Zentralnervensystem bei Spätnarkosetodesfällen und bei Todesfällen nach Lumbalanästhesie, Ztschr. f. d. ges. Neurol. u. Psychiat. **117**:366, 1928.

and Cobb. Buzzard and Greenfield [54] stated that partial interference with the blood supply produces changes similar to those due to various poisons. These changes correspond to those described in the work of Gildea and Cobb. Similar pathologic lesions have been described by Spielmeyer [55] in the brains of patients who died from various forms of vascular disease that are supposed to produce cerebral anemia.

The work of these investigators cannot be disregarded. The effect of asphyxia in medical conditions and the administration of nitrous oxide in particular will probably reveal interesting observations in future clinical and clinicopathologic investigations.

In considering nonsuppurative, nonepidemic encephalitis in labor and the puerperium, one must bear in mind as possible etiologic factors an endogenous toxic state related to pregnancy, a latent infection and the possibility of cerebral asphyxia incident to the common use of anesthesia.

In the case of my patient it was thought that the third factor, namely, cerebral asphyxia, played an important rôle. There was nothing about the course of the patient's pregnancy to suggest a preexisting endogenous toxic state that would account for the sudden stormy onset immediately after delivery. Nor were there any history or objective observations of any latent infection except the benign stomatitis a few days preceding the labor. What appeared significant at the bedside from the start was the cyanosis long after the nitrous oxide anesthesia was discontinued, and the rapid and widespread involvement of the brain. It was thought that we were dealing with a cerebral change due to an anoxemia, possibly caused by insufficient oxygen. The cerebral ischemia would account for the rapidity and diffuseness of onset, for the primary improvement and the subsequent development of the edema of the brain, and the eventual, almost complete functional recovery.

SUMMARY AND CONCLUSIONS

From a review of the literature it appears that nonepidemic, nonsuppurative encephalitis is a clinical syndrome that may be produced by a variety of endogenous and exogenous toxic infectious states and that pathologically shows a diversity of changes, inflammatory, degenerative and purely vascular. At present it would seem impossible for clinical purposes to adopt a strictly pathologic classification. From the therapeutic standpoint, the etiologic and clinical diagnosis is of as great importance as the purely pathologic one.

54. Buzzard, E. F., and Greenfield, J. G.: Pathology of the Nervous System, New York, Paul B. Hoeber, Inc., 1922, p. 13.

55. Spielmeyer, W.: Vasomotorische trophische Veränderungen bei zerebraler Arteriosklerose, Monatschr. f. Psychiat. u. Neurol. **68**:605, 1928.

In nonsuppurative, nonepidemic encephalitis following labor and in the puerperium, the etiologic factors to be considered are the toxic states related to pregnancy, latent infections that are precipitated by labor or become evident in the puerperium and the possible etiologic factors incident to modern obstetrics, especially the widespread employment of general anesthesia.

A case is reported of nonepidemic, nonsuppurative encephalitis, occurring immediately after labor and probably due to anoxemia, with almost complete recovery.

Caution should be exercised in tapping spinal fluid in the absence of meningitis and the presence of clinical evidence of marked edema of the brain. Dehydration by limiting the intake of fluids and by the intravenous administration of a hypertonic solution, such as 50 per cent dextrose, is stressed.

Clinical Notes

INCIPIENT PARKINSONISM

A Group of Objective Symptoms of Value in Its Early Recognition *

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Few problems in medicine today are more trying than that of chronic epidemic encephalitis, the hopelessly advanced cases being a problem in every institution. The treatment for the disease is scarcely more than symptomatic, and the great number of drugs recommended does little more than testify to the inefficacy of the whole group. The causative organism has not been definitely accepted as any one of the many that have been isolated by various workers. The work of Stewart and Evans [1] is promising, but is far from conclusive at this time.

Because of the lack of satisfactory therapeutic measures one is not excused from making the diagnosis at the earliest possible time. The merit of any treatment is largely dependent on the stage of the disease in which it is applied, and no method of treating encephalitis that exists at present or may be developed in the future can be of great value in advanced parkinsonian states.

In 1929, Ornsteen [2] described a triad of signs of the hand that has proved of great value in recognizing incipient and fragmentary forms of encephalitis. These are: (1) The posture of the finger in repose; most cases show more advanced involvement on one side than on the other, and on the more involved side a greater degree of flexion of the fingers is noted at the interphalangeal joints. (2) Spacing of the fingers in the outstretched hand; in the normal person the spacing is equal and symmetrical, while in incipient parkinsonian states there is inequality and asymmetry. (3) Test for thumb and forefinger; the patient is made to hold the hands in front with all fingers except the thumb and index finger flexed into the palm. He is then told to touch rapidly the tips of the thumb and the index finger together. In the abnormal hand an early exhaustibility and decrease in the agility of the movement with limitation of the amplitude are noted. These postural and tonectic changes occur in many cases before other more familiar signs of parkinsonism are established.

For over a year I have studied established and fragmentary forms of parkinsonism for these and other signs and have noted the following signs, which are present in the very earliest cases that I was able to study in the wards of the Philadelphia General Hospital and elsewhere. All of these signs are dependent

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* Read at a Meeting of the Philadelphia Neurological Society, Nov. 28, 1930.

* From the Neurological Department of the University of Pennsylvania School of Medicine and the Philadelphia General Hospital.

1. Stewart, W., and Evans, M.: Preliminary Report of Bacteriological Studies and Treatment of Chronic Epidemic Encephalitis, Am. J. M. Sc. **180**:256 (Aug.) 1930.

2. Ornsteen, A. M.: Incipient Parkinsonism: A Diagnostic Triad for Its Early Recognition, Arch. Neurol. & Psychiat. **22**:709 (Oct.) 1929.

on the early exhaustibility of muscles in the performance of rapidly interrupted movements, and they are noted in the finely coordinated movements of the eyelids, lips and tongue.

1. When the patient is made quickly and lightly to close and open the eyes as rapidly as possible and to do it without interruption, one notes that soon the movements of the lids become fluttery. They are not completely closed or completely opened, and the effort usually ends by the accessory muscles coming into play or by the fluttering of the eyelids.

2. The patient is instructed to open the mouth widely and to put the tip of the tongue behind the upper front teeth and then rapidly to move the tongue in and out, scraping the tip on the upper teeth. At the onset this movement is usually slower than normal, and soon the tip of the tongue cannot be made to scrape on the teeth, and the tongue is just moved in and out of the mouth, the rate of movement and the amplitude decreasing rapidly until there is merely a sluggish ineffective movement of the tongue within the mouth.

3. The patient is instructed to close the mouth firmly and with the upper and lower jaws approximated to smack the lips rapidly, and indefinitely to repeat the smacking. Usually after a few smacks the smacking becomes inaudible and the lips are no longer approximated and pulled apart forcefully or quickly enough to cause sound.

To appreciate these signs as indicative of the exhaustibility of muscle resulting from the tonectic disturbance, one should note them in a patient with a moderately established parkinsonian state and compare them with those in a normal person. By a little experience one can learn quickly to note the variations from normal and to recognize many incipient parkinsonian states.

SUMMARY

There is nothing characteristic about the subjective symptoms of incipient parkinsonism, so that its early recognition must depend on objective physical disturbances. Practically all of the symptoms of the parkinsonian state depend on tonectic disturbances. I believe that the tests described in this communication and in those of Ornsteen will be an aid in the early diagnosis of incipient parkinsonian states.

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MULTIPLE TUMORS OF THE SKULL SIMULATING OSTEOMYELITIS *

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The diagnosis and treatment of neoplasms that on clinical examination present the picture of inflammatory lesions often prove extremely difficult.

REPORT OF CASE

History.—A boy, aged 5, came to the Mayo Clinic with the complaint of a draining sinus in the forehead. The child had been delivered normally, weighed 9½ pounds (4.3 Kg.) at birth, and development had been normal. His teeth

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* From the Section on Neurologic Surgery, the Mayo Clinic.

appeared at the age of 5 months and he walked at the age of 16 months; he was breast fed for seventeen months and spoke intelligibly at the age of 2 years. Six months previous to being registered at the clinic, he sustained a bump on the forehead which was not very severe; two weeks later, a swelling appeared which increased to about 6.25 cm. in diameter, and following hot applications some fluctuation was detectable in the mass. The attending physician incised the mass two months after the initial trauma, and pus escaped; the sinus continued to drain, and a second operation was done three months after the primary one. At that time, a great deal of pus escaped from the wound; the child's temperature became elevated; he lost appetite, became constipated and lost a great deal of weight. Two months before admission to the clinic, a soft mass appeared over the right parietal region.

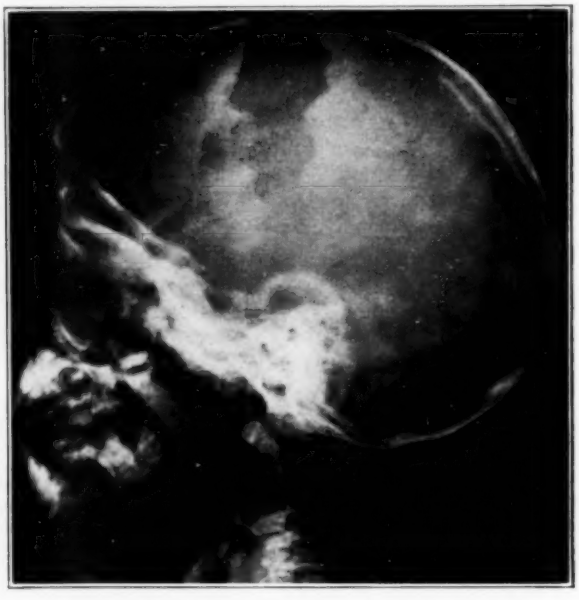

Fig. 1.—Destruction of bone in the skull.

Examination.—The patient was 43 inches (109.22 cm.) in height and weighed 29 pounds (13.2 Kg.) A pustular, papular eruption was found to extend over the entire scalp; this eruption was noted also over the body and was diagnosed in the Section on Dermatology and Syphilology as molluscum contagiosum. A small sinus was present in the midfrontal region from which pus characteristic of infection with staphylococci was draining, and the surrounding region was soft and fluctuating. A soft, fluctuating mass could be palpated also in the right parietal region; this was not connected with the mass in the midfrontal region. Definite ptosis of the right eye and exophthalmos on the same side were very noticeable; gingivitis was definite, and there was much necrosis of the gums. The pulse rate was 94 beats each minute, and the temperature was 101.4 F. The specific gravity of the urine was 1.007, and the reaction was alkaline; neither albumin nor sugar was present. The microscopic examination gave negative

results, and Bence-Jones protein bodies were not detected. The hemoglobin content of the blood was 74 per cent; erythrocytes numbered 4,240,000, and leukocytes 11,800 in each cubic millimeter of blood. On differential count, the proportion of lymphocytes was 2.25 per cent; of transitionals, 1.5 per cent; of neutrophils, 75 per cent, and of eosinophils, 1 per cent. Repeated examination of the blood did not show evidence of leukemia, and the Wassermann reaction of the blood was negative. The ocular fundi and visual fields were normal. Examination of the nose, throat and ears revealed enlarged tonsils and impacted cerumen in both external auditory canals. Roentgenograms of the head gave evidence of large,

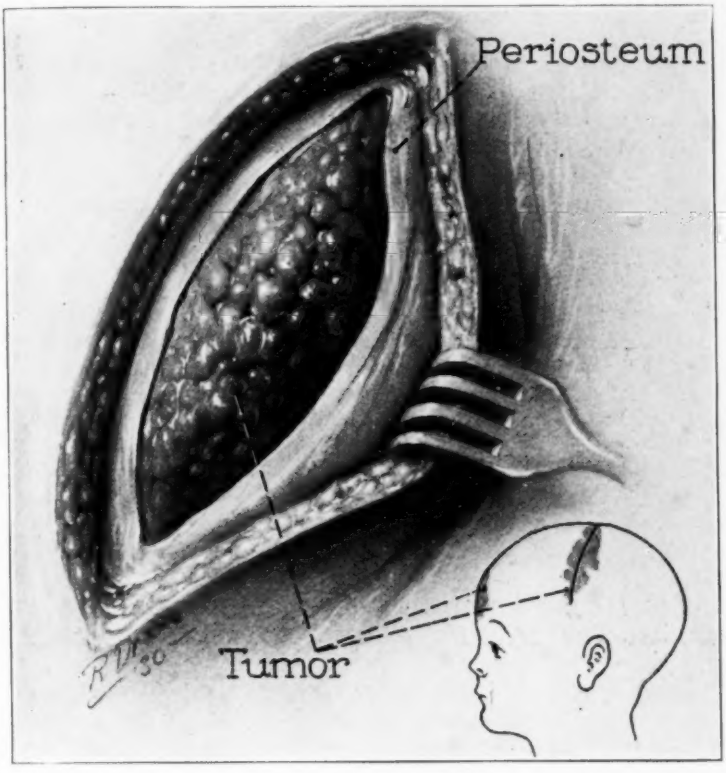

Fig. 2.—Appearance of tumor before removal.

irregular regions of destruction of bone in the right parietal region, in the right frontal region and in the midfrontal region, and a diagnosis of xanthomatosis was suggested (fig. 1).

Course.—Treatment was instituted for the gingivitis and the molluscum contagiosum, and the condition of the skull was considered as being due either to neoplasm or to inflammation. The general impression of the condition was that multiple regions of chloroma were present, but because of the draining sinus in the midfrontal region, the appearance of the roentgenogram of the head and the elevation of temperature, it was thought that the condition might be osteomyelitis.

Operation.—Because of these observations, therefore, surgical exploration was performed, and following an incision over the right parietal region, a greenish-yellow tumor, which had the gross appearance of chloroma, was found beneath the periosteum. A large portion of the tumor was removed, following which the wound was then closed. The draining sinus over the midfrontal region was curetted for diagnosis and was found to contain material similar to that found in the tumor removed from the right parietal region, except that the material from the sinus was infected. The sinus was curetted and was swabbed with iodine (fig. 2).

Histology.—The microscopic picture was that of a vascular, cellular tumor with regions of necrosis. Scattered throughout the field were numerous large mononuclear cells which contained lipoid substance, numerous eosinophils and polymorphonuclear leukocytes. The proliferating endothelial cells from the walls of the small vessels predominated, giving the impression of hemangio-endothelioma. The regions of necrosis and the cells containing lipoid evidently caused the greenish-brown appearance on gross examination.

Outcome.—The patient recovered uneventfully and the wounds healed without drainage. Because of the type of tumor found, and because treatment with radium had been beneficial in similar cases, three treatments with radium were given on successive days.

COMMENT

Previous to operation, a diagnosis of neoplasm was suggested in this case, since the clinical characteristics of this type of tumor consist usually of a blood picture of leukemia, proptosis and exophthalmos, with roentgenologic evidence of destruction of bone. The clinical picture in this particular case was that of destruction of bone associated with a draining sinus in the frontal region, proptosis of the right eye, slight leukocytosis, elevation of temperature and absence of the blood picture of leukemia.

OCCLUSION OF THE RIGHT POSTERIOR INFERIOR CEREBELLAR ARTERY AND RIGHT VERTEBRAL ARTERY*

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The symptom complex following occlusion of the posterior inferior cerebellar artery or the vertebral artery has been frequently described in the literature, and its diagnostic importance has been emphasized. Most observers, however, who have reported cases of this syndrome have not been able to obtain necropsies in their cases, because in many instances the patients recovered. We recently observed a case which was unusual clinically in that both the posterior inferior cerebellar artery and the vertebral artery of the right side were involved almost simultaneously.

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* From the Department of Neurology and Psychiatry, University of Texas Medical School.

Several observers have noted that it is difficult at times to differentiate clinically between occlusion of the posterior inferior cerebellar and the vertebral arteries, and others in reports on the bulbar syndrome have included cases of occlusion of the vertebral artery as well as of the posterior inferior cerebellar artery. Spiller [1] (1908) reported two cases with postmortem observations, both, strange to say, showing involvement of the vertebral and posterior inferior cerebellar arteries. One of Thomas' [2] cases (1907) showed the same complication, but no microscopic lesions were present. Ramsbottom and Stopford [3] (1924) mentioned that it is difficult to distinguish between thrombosis of the vertebral and of the posterior inferior cerebellar artery, but called attention to certain anatomic points that are helpful in making a differential diagnosis. Hall [4] (1920) stated that, clinically, one cannot be sure whether one is dealing with an occlusion of one or the other artery. Gordinier [5] (1930) reported a case and called attention to pertinent facts concerning the symptom complex of occlusion of the left posterior inferior cerebellar artery. He also presented a collected bibliography.

REPORT OF CASE

History.—D. H., aged 49, a habitual hunter, entered the John Sealy Hospital on Feb. 14, 1929, complaining of severe headache and fever. The illness had begun about five months previously (September, 1928) with severe pains in the lower extremities, especially the left. He described these pains as "rheumatic," and it was thought that they were due to neuritis, myositis or fibrositis. This condition persisted until November, 1928, and was accompanied by a somewhat rapid loss in weight of almost 50 pounds (22.7 Kg.) within five months. The patient then began to have occipital headaches at night. In addition, he noticed that his mouth became very sore, with the appearance of white patches along the edges of the tongue and inner surface of the lips; this was accompanied by sore throat. The condition of the mouth cleared up in ten or twelve days, but the nocturnal headaches became more intense.

On Feb. 6, 1929, a severe attack of dizziness suddenly developed (the patient stated that he felt as though he was "drunk"), and he had to be conveyed home in a car. On the same night and for four succeeding days there were cramping pains over the epigastrium, shifting to the back and right side. The patient was unaware of any fever, but two days later, his physician noted an elevation of temperature to 103 F. and advised entrance into the hospital. Other symptoms noted during the five months previous to admission included a loss in weight from 181 to 134 pounds (from 82.1 to 60.8 Kg.) and nocturia about five times a night. There were no cough, night sweats or diarrhea, and the appetite was fair.

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1. Spiller, William G.: The Symptom-Complex of Occlusion of the Posterior Inferior Cerebellar Artery: Two Cases with Necropsy, J. Nerv. & Ment. Dis. **35**:365, 1928.

2. Thomas, H. W.: Symptoms Following the Occlusion of the Posterior Inferior Cerebellar Artery, J. Nerv. & Ment. Dis. **34**:48, 1907.

3. Ramsbottom, A., and Stopford, I. S. B.: Occlusion of the Posterior Inferior Cerebellar Artery, Brit. M. J. **1**:364 (March 1) 1924.

4. Hall, George W.: Occlusion of the Right Posterior Inferior Cerebellar Artery, J. A. M. A. **74**:1157 (April 24) 1920.

5. Gordinier, Herman C.: The Report of a Case of Occlusion of the Left Posterior Inferior Cerebellar Artery, J. Nerv. & Ment. Dis. **71**:1 (Jan.) 1930.

The family history was without significance; the patient had never been ill until five months previous to admission. His habits were not abnormal; he used alcohol moderately.

Physical Examination.—On admission there was noticeable enophthalmos of the right eyeball. A careful neurologic examination was not made until later, because the case was thought to represent some obscure acute infectious disease.

Course.—On February 19, he complained of diplopia and transient blurred vision. On February 20, he said that he could not see with the right eye, and a right internal strabismus and nystagmus were noted. On February 21, he complained of hypesthesia of the right side of the face. On February 23, it was observed that the left pupil was larger than the right, and that the right reacted sluggishly to light.

On February 27, a neurologic examination revealed unequal pupils, right facial hypesthesia, staggering to the right side and an equivocal bilateral Babinski sign. Careful sensory examination was unfortunately not made. A few days later, while a low grade fever continued, it was noted that the right palpebral fissure was smaller than the left, but the significance was not surmised at this time.

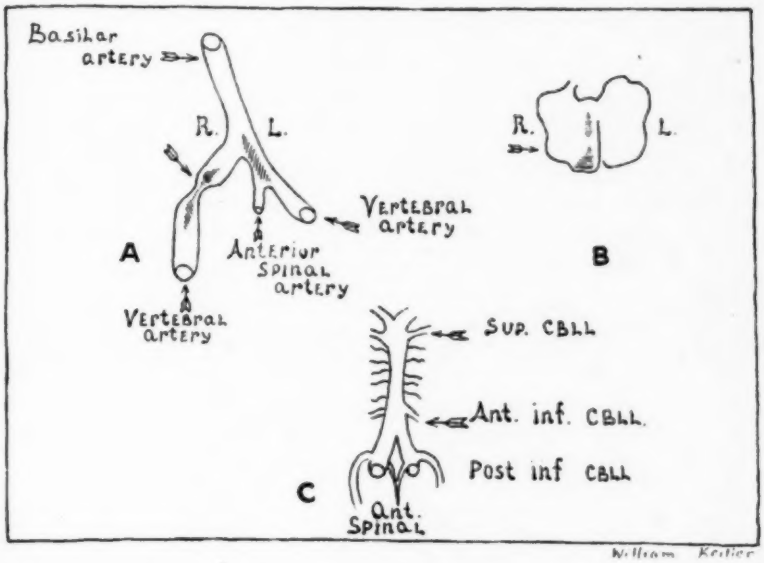
On March 9, while the patient was still in the hospital, about fifteen hours after a spinal puncture, he complained of numbness over the entire left side of the body. He became semistuporous, and on examination it was noted that a left hemiparesis had developed. Further examination at this time showed: (1) marked left hemiparesis; (2) deviation of the tongue to the right when protruded; (3) slight (fine) nystagmus in all directions; (4) right corneal hypalgesia; (5) hypesthesia over the left lower extremity and left side of the body up to about the tenth and eleventh dermatomes; (6) drooping of the right eyelid, and (7) miosis on the right. The patient was anxious about his condition and somewhat dazed from the suddenness of the attack. On the following day, the left-sided hemiplegia was more complete, and horizontal nystagmus, which was more marked on the right side, was definitely established. The clinical impression at that time and in retrospect of the symptoms noted previously was that the syndrome represented an "occlusion of the right vertebral artery adjacent to where the right posterior inferior cerebellar artery and anterior spinal artery branch off, having involved the former branch primarily."

On March 14, the patient was removed from the hospital against the advice of his physicians. He was brought back on March 31 in a moribund state, markedly enfeebled, with an increase in all of the signs and symptoms noted on dismissal, and in addition with a rather marked dysarthria and dysphagia. He died on April 1.

Laboratory Tests.—Various laboratory tests showed that the urine was normal. Examination of the blood on two occasions revealed: white cells, 15,350 and 10,100; in all other respects the blood was normal. The Wassermann reaction of the blood was negative. Cultures of the blood on two occasions gave negative results. A Widal test was negative for paratyphoid A and B. The examination of the blood serum was negative for undulant fever and tularemia, as reported from the United States Hygienic Laboratory. The spinal fluid on two occasions showed: globulin, normal; sugar, normal; 26 lymphocytes at the first, and 4 lymphocytes at the second examination; the Wassermann test was negative on both occasions; Lange's colloidal gold curve was 0112210000 and 1223310000. Roentgen examination of the skull and sinuses showed an old right maxillary sinusitis. An examination of the visual fields showed a small central scotoma on the right side.

Autopsy.—Only the brain was obtained for autopsy. Grossly, the right vertebral artery showed a peculiar narrowing 1 cm. before it joined the basilar artery (see chart, *A*); this narrowing was thought to be congenital (compare with *C*). There was no thickening of the arterial coats and no evidence of local disease. The right posterior inferior cerebellar artery was not seen, but it was believed to have been removed by the pathologist at autopsy. On cross-section the medulla oblongata showed definite softening, involving chiefly the right pyramidal tract and the right medial lemniscus.

On microscopic examination, the most cephalic section showed a large area of degeneration on the right side of the medulla oblongata, which completely involved the right pyramid and the right medial lemniscus. The fila of the twelfth nerve, which passed through the lesion, were also involved. More caudad there was degeneration of the pyramid alone, while still farther caudad there was only par-



Sketches showing narrowing of the right vertebral artery (*A*), probably a congenital defect, and macroscopic softenings in the right side of the medulla oblongata (*B*), as seen in a postmortem specimen (*A*); (*C*), normal appearance of the anterior spinal artery (after Cunningham).

tial degeneration of this structure. At this level there was a triangular area of degeneration behind the inferior olivary body which corresponded in position with the ventral spinocerebellar and spinothalamic tracts and also with the situation of the tract that conveys the higher control of the sympathetic ciliospinal center. There was thickening of the ependymal lining of the floor of the fourth ventricle, which suggested a syphilitic etiology, though this was not found clinically. The degenerations, as far as could be observed from the sections, were benign and were due to vascular interruption. Thus, on the right side there was evidence of degeneration or involvement of the following structures: (1) medial lemniscus; (2) pyramidal tract; (3) ventral spinocerebellar tract; (4) spinothalamic

tract; (5) diencephalic or subthalamic sympathetic pathway; (6) hypoglossal nerve; (7) nucleus ambiguus, and (8) part of the formatio reticularis.

COMMENT

In the light of the clinical history in this case, we believed that we were dealing with an occlusion of the right posterior inferior cerebellar artery of infectious origin, which had slowly extended upward so as to involve the right vertebral artery. The clinical picture for weeks was that of an acute infectious disease, but a careful search by laboratory and other methods failed to reveal an etiologic basis. Our first clinical impression was that the process began as an infectious arthritis, probably in the lower extremities. It finally localized in the right vertebral and right posterior inferior cerebellar arteries, as confirmed by autopsy. For purely anatomic reasons, as noted in the diagram of the postmortem observations, the latter artery was more vulnerable, and thrombotic occlusion occurred there first; then the previous constriction of the vertebral artery produced the final lesion.

SUMMARY

A survey of the literature reveals that thrombosis or occlusion of the posterior inferior cerebellar and the vertebral arteries occurs not uncommonly at the same time. A case is reported, with postmortem observations, in which the area of supply of both arteries was involved. The patient showed the usual bulbar syndrome following occlusion of the right posterior inferior cerebellar artery, and later showed signs indicating extension of the process to the right vertebral artery.

CORRECTION

In the article by Drs. Syz and Kinder, entitled, "The Galvanic Skin-Reflex" (ARCH. NEUROL. & PSYCHIAT. **26**:146 [July] 1931), the following section was omitted from table 2, page 150, between the sections "Sex" and "Self."

Depressive	degenerate	poor health	lonely
	lonely	suicide	misspent youth
	social failure	friendless	insane
	misspent youth	invalid	poor health
	dishonest transaction	no future	suicide
	insane	disease	
	death	inferior	
	unforgiven	unpopular	
	poor sufferer	failure in life	
	downhearted		

News and Comment

AMERICAN NEUROLOGICAL ASSOCIATION

The 1932 officers of the Association will be: president, Dr. Bernard Sachs, New York; vice presidents, Dr. Harvey Cushing, Boston, and Dr. D. J. McCarthy, Philadelphia; secretary-treasurer, Dr. H. A. Riley, 117 East Seventy-Second Street, New York.

Abstracts from Current Literature

A Case of Paralysis of the Lateral Movements of the Eyes from a Pontile Lesion: A Contribution to the Study of Oculogyric Pathways. Paul van Gehuchten, Rev. d'oto-neuro-opht. **8**:101 (Nov.) 1930.

Stimulated by the suggestion of André-Thomas that a large number of careful postmortem observations in cases of associated paralyses of the ocular muscles are necessary in order to enhance knowledge of the mechanism involved, van Gehuchten records the complete history in a case, with detailed autopsy observations and serial microscopic sections of the brain stem. This is followed by a discussion of the known facts about the nerve pathways and by a comparison of the lesions in his case with these facts.

The patient, aged 30, suffered from phthisis. The ocular symptoms began with diplopia, due to paralysis of the left external rectus muscle, which was soon followed by conjugate deviation of the eyes to the right and paralysis of the left facial nerve. Later, trouble in walking (deviation to the left), vertigo, vomiting and occasional headaches appeared. Convergence was well executed. When the patient looked to the right, an intense nystagmus to that side was noted. In March, an examination revealed, in addition: hypesthesia in the domain of the right trigeminus nerve, hypo-excitability of the left labyrinth and a slight pyramidal lesion, characterized by a positive Babinski sign on the right. These observations would be explained by a lesion situated in the left side of the bulb near the floor of the fourth ventricle at the level of the knee of the facial nerve. The condition grew progressively worse, and, six months later, another examination showed: unchanged ocular paralysis, disappearance of the spontaneous nystagmus, accentuation of the facial paralysis, slight diminution of hearing in the left ear, paralysis of the recurrent nerve, little reaction to stimulation of the left vestibular apparatus and paralysis of the left trigeminus nerve. Death occurred one month later.

Autopsy revealed a large whitish tumor (tuberculoma) in the bulb and pons situated to the left of the median line and extending from the middle of the bulbar olive to the upper limit of the pons. Its greatest development was at the middle part of the pons. It did not appear to traverse the midline. A résumé of the microscopic appearances showed that to the left of the median line, the reticulated substance was destroyed in the whole extent of the pons; the left olive was partly involved; the nuclei and fibers of the tenth, eighth, seventh, sixth and fifth nerves were destroyed; the ribbon of Reil was greatly altered; the pyramidal tract was slightly involved. On the right, the olive was greatly atrophied . . . The most interesting lesions were those of the posterior longitudinal bundles. The tumor destroyed the left posterior longitudinal and predorsal bundles and slightly damaged the right posterior longitudinal bundle. Beneath the lesion, the right posterior longitudinal bundle appeared normal, while the one on the left was much atrophied. Above the lesion could be seen the reestablishment, little by little, of the left posterior longitudinal bundle. Numerous fibers passed the median line, and higher up the bundle was seen to be reformed. In the superior part of the segment (fourth pair), to the left of the side damaged, the compact part of the posterior longitudinal bundle was reestablished. A zone of atrophy persisted between the compact and the lateral parts. Finally, the lateral zone remained atrophied. On the right, the most internal zone was well conserved, but the middle part of the compact zone was atrophied to such a degree that the posterior longitudinal bundle appeared more affected on the right than on the left side. On the other hand, in its lateral part, the posterior longitudinal bundle was well conserved.

The vestibular fibers of the posterior longitudinal bundle come principally from the triangular, the descending and Bechterew's nuclei. The last named are homolateral, located in the lateral (fringed) part of the posterior longitudinal

bundle and constitute the vestibulomesencephalic bundle. The fibers from the descending and triangular nuclei are crossed; they pass the raphe and divide into ascending and descending fibers. The ascending fibers are situated in the compact internal zone of the posterior longitudinal bundle and enter the nuclei of the third and fourth nerves. The nonvestibular fibers are solely descending fibers and originate from the reticulated cells of the mesencephalon, the periacqueductal cells and the reticulated cells of the bulb and the pons. Muskens described three descending bundles: commissuromedullary, interstitiospinal and a lateral bundle (Probst).

A comparison of these anatomic data with the observations in the serial sections reveals that the left posterior longitudinal bundle and the left vestibular nuclei were destroyed by the lesion, which must cause degeneration of all the descending fibers of the left posterior longitudinal bundle originating in the commissural, interstitial or left vestibular nuclei, but the fibers from the right vestibular nuclei should persist. The sections show this to be the case. About the lesion on the left, degeneration of the direct vestibular fibers from Bechterew's nucleus should be found, and the fibers originating in the triangular and descending nuclei must be degenerated only so far as they pass the median line at the level of the tumor. The sections show complete atrophy of the fibers from Bechterew's nucleus; a part of the fibers from the triangular and the descending nuclei are intact and cross the median line above the damaged area to occupy the median and lateral parts of the posterior longitudinal bundle. Others are degenerated, especially at the junction of the compact and fringed parts of the ventral zone of the posterior longitudinal bundle.

On the right side, all of the fibers originating in the left vestibular nuclei, except those coming from the descending nucleus below the lesion which have been able to cross the median line, should show degeneration. In fact, the sections on the left side show an intact central zone, formed by the descending fibers, a degenerated intermediate zone, formed by the superior vestibular fibers, and an intact, more external zone, corresponding to the degenerated zone of the left posterior longitudinal bundle. They are the fibers originating in the left descending nucleus that had passed the median line below the tumor. The lesion destroyed almost all the fibers sent to the right posterior longitudinal bundle from the left vestibular nuclei, except those from the left descending nucleus which cross the median line below the lesion. These degenerated fibers terminate in the right third nucleus. This explains the paralysis of the left lateral gaze. Other ascending bundles are degenerated, but this is less important. It seems, then, that the oculogyric pathway, a lesion of which determines deviation of the eyes to the right, is composed of the degenerated fibers that are found in the middle zone of the right posterior longitudinal bundle.

Experimental researches have shown that the sixth nerve does not send fibers to the posterior longitudinal bundles. The development of the symptoms in this patient proves that it was not the lesion of the sixth nucleus that determined the lateral paralysis of the gaze. The tumor must first have developed near the sixth nucleus and the knee of the facial nerve, since the patient showed first a paralysis limited to the left external oculomotor and facial nerves. It was not until some time afterward that the paralysis of gaze to the left appeared, and still later that the first signs of trouble in the vestibular nuclei were noted. The triangular nucleus is most intimately connected with the nucleus of the external motor oculi, and it may be asked if it is not the invasion of its most internal part that caused the lateral paralysis. Winkler believed that Fuse's nucleus, lying between the sixth nerve and the triangular nuclei, may be regarded as a center that regulates the tonic innervation of the homolateral external rectus and, by way of the posterior longitudinal bundle, that of the crossed internal rectus muscle. Disease of this nucleus would produce paralysis of gaze toward the damaged side. It then appears probable that, in lateral gaze, the oculomotor nuclei are synergistically directed by a center near the sixth nucleus (Fuse's nucleus). In man, a lesion of the vestibular nuclei causes a conjugate deviation of the eyes only if the lesion is

seated in Fuse's nucleus and the deviation is toward the side opposite the lesion. In animals, an unimportant lesion of the vestibular nuclei or nerve causes a conjugate deviation toward the side of the lesion.

No conclusion is reached as to the localization of the descending pathways that control lateral gaze. Winkler and Muskens studied this problem. The latter thought that the descending pathway, originating in the corpus striatum, has a relay in the posterior commissure, and that the fibers from this nucleus cross the median line to the opposite posterior longitudinal bundle. In the case reported, the entire left posterior longitudinal bundle was destroyed at the level of the sixth pair. The deviation of the eyes to the right could then be the result of a lesion of the descending and ascending oculogyric pathway.

DENNIS, Colorado Springs, Colo.

THE CLINICAL PICTURE AND PATHOLOGY OF MERCURY POISONING. W. GUILJAROWSKY and A. WINOKUROFF, Ztschr. f. d. ges. Neurol. u. Psychiat. **121**:1, 1929.

Guiljarowsky and Winokuroff report seven cases of poisoning caused by mercury; they occurred in two families. Two brothers, both married, began, in September, 1925, to do piece-work in the preparation of thermometers with the help of three unmarried brothers. The work was carried out in two badly ventilated homes, only one of which had a window for ventilation. The symptoms of poisoning first appeared in the family occupying the latter home. The three unmarried brothers who took part in the work did not sleep in the homes where the work was done, and the mercurial poisoning did not develop in them. After work, the glass and mercury were thrown on the floor and rarely cleaned out.

The families of the two married brothers were affected. In the first family, mercurial poisoning appeared in the father, mother and two children, aged 5 and 3 years. The father became ill with stomatitis, colitis, neuritis, tremors of the hands, pains in the head and neck and nervousness. He showed a rather slurring speech, emotional lability, loss of memory, difficulty in concentration and a definite hypochondriacal trend. The pupils were sluggish; there were tremors in the region of the orbicularis oris, perseveration of movements, such as opening the mouth or closing the eyes, marked hyperactivity of the patellar reflexes, a Romberg sign and a definite disturbance of speech. He complained constantly of the fact that his tongue did not belong to him. The mother, aged 28, became ill one month after her husband with stomatitis, headaches, insomnia, nervousness and a definite feeling of anxiety. She showed only a tremor of the hands and of the closed eyelids, and a depressed right knee reflex. The children became ill about four months after the mother. In the elder, aged 5, a bright, quiet youngster, fever developed, and he complained of pain in the stomach. He had diarrhea and blood in the stools. After a week in bed, he was very thin, dropped objects from his hands, showed tremor of the hands, became mentally deficient, showed disturbances in consciousness, soiled himself, played with his genitals and became definitely imbecilic. He showed dilated pupils, limitation of movement of the eyeballs in all directions, divergent strabismus, bilateral ptosis, spasmodic blinking, spasticity of the facial muscles, spasms of the muscles of mastication and sometimes of swallowing, hypotonia of the lower extremities, a gait with a wide base, hyperactive knee reflexes and loss of control of the bladder and the rectum. There was 42 per cent of mercury in the blood. He was much below par mentally. His sister, aged 3, became ill at the same time and with similar complaints. She showed a marked horizontal nystagmus, strabismus, left hemiparesis, hypotonia and marked weakness of the upper extremities with periodic spastic phenomena. She also had spasm of the muscles of mastication, fibrillary twitchings of the face, especially about the eyes and the mouth, isolated twitchings in the extremities, a dysbasic gait with a wide base, hyperactive patellar reflexes and a Babinski sign on the left. Mentally, she exhibited marked anxiety, defects of speech and a decreased mentality.

In the second family, the mother and three children, aged 7, 2½ years and 6 months, were taken ill simultaneously. The mother complained of pains in the gums, diarrhea, nervousness, headaches, marked anxiety and a tendency to cry easily; she worried frequently. She showed a masklike facies, ptosis, divergent strabismus, paresis of the orbicularis oris, trismus, weakness and hypotonia of the upper extremities, tremor of the hands, anisocoria and marked emotional instability, but no loss of mental powers. The father showed no evidence of poisoning. The girl, aged 7, became ill with headaches and loss of power in the upper extremities. She showed anisocoria, twitchings of the facial muscles, a definite weakness of the left side of the face (peripheral), a relative weakness of the left masseter, a more pronounced weakness of the left temporal muscle, spasticity of the fingers of the right hand, intention tremor and choreo-athetotic movements. There were an insignificant rigidity of the extremities, loss of motion of the arms in walking, an ataxic gait (mild) and aphasia. She showed a definite decrease in mental power. The blood showed 38 per cent of mercury, and mercury (0.06 mg.) was present in the urine. The younger child became ill with similar symptoms. She showed an ataxic gait, hypotonia of the upper extremities, disturbances in equilibrium and intention tremor. Mentally, she was dulled, and showed an extreme anxiety. Mercury was recovered in the urine (0.04). The youngest infant, aged 6 months, showed numerous furuncles but few neurologic symptoms. She died, and a necropsy was obtained.

Study of the fatal case showed proliferation of the connective tissue, the vascular endothelium and the cells of Schwann and swelling of the myelin sheaths in the peripheral nerves. The sympathetic ganglia showed shrunken cells in the process of neuronophagia, with the neurofibrils either absent or much broken up. The brain showed hyperemia, with numerous hemorrhages in the cortex. Changes in the cortex were most marked in areas 8, 7, 19 and 22. There were thickening of the pia, infiltration with lymphocytes and macrophages, numerous venous thromboses, central chromatolysis of the cells of layers 3 and 5 in the cortex and fat either in the perivascular spaces or in gitter cells, especially in the deeper layers of the cortex. There were small hemorrhages in the cornu ammonis and vessels filled with streptococci. The basal ganglia showed destruction of the cells of the lenticular nucleus, with a marked increase in the satellite cells. The thalamus was normal. The ependyma of the third ventricle was hyperplastic. The cord did not show changes. In isolated cells of the anterior horn one could see mild chromatolytic changes. The vessels often showed marked endarteritic changes, and in the cortex in some areas streptococci were found in the vessels. Proliferative neuroglial changes were present.

The changes in the brain were more marked in the subcortical ganglia than in the cortex. Two factors played a rôle: intoxication and infection. Of these, the intoxication was by far the more important, the infection being purely secondary. It is known from experiment that mercury decreases the resistance of the organism and makes infection easy.

It is hard to say from this case just what the changes due to mercurial poisoning are. A case of mercurial poisoning was reported by de Crinis in a man, aged 20, who took sublimate and died eleven days later. Necropsy showed tigrolysis of the cells of the central and frontal areas and of the cornu ammonis, with swelling of the cells and increase in satellite cells. Most of the changes were in the third layer. There was also hyperplasia of the fibers and neuroglia. Guiljarowsky and Winokuroff state that mercurial poisoning causes marked dementia, with changes in character consisting of querulousness, fear and anxiety reactions and depression.

ALPERS, Philadelphia.

TWO ANATOMICOCLINICAL OBSERVATIONS OF PARALYSIS OF MOVEMENTS OF LATERALITY OF THE EYES. J. FROMENT, J. DECHAUME and A. COLRAT, Rev. d'oto-neuro-opht. **8**:713 (Nov.) 1930.

The question of the existence of supranuclear centers for coordinated movements of the eyes is not yet settled. The problem of the anatomic substratum and the physiopathology of paralysis of function still presents unknown factors.

Two cases are reported. The first was that of a child, aged 8½, with conjugate deviation of the eyes to the right, headaches, vomiting, papillary edema on the right and paralysis of lateral gaze to the left (both voluntary and automatic reflexes). Convergence was normal, and there was no paralysis of the facial or the external motor oculi nerves. Death occurred one day following the sudden development of hemiplegia and facial paralysis on the right side. At autopsy, a glioma was found, involving the floor of the upper half of the left side of the fourth ventricle. The tumor did not involve the sixth nucleus. The left posterior longitudinal bundle was destroyed, and the infiltration extended upward as high as the red nucleus, into the foot of the left peduncle and the median part of the right peduncle.

The second case was that of a boy, aged 14, with occipital headaches, disturbed vision in the left eye and deviation of the eyes to the right. The vertical movements of the eyes were normal. On examination, left oculogyric paralysis of voluntary and automatic reflex movements, with preservation of convergence; (later on, dextrogyric paralysis was noted); paralysis of the left external motor oculi nerve; left peripheral facial paralysis; right hemianesthesia and paresis, and cervical adenitis were found. The eyegrounds were normal. Death occurred four months after admission. Autopsy revealed pulmonary tuberculosis, two tubercles the size of a hazel nut in the right temporal lobe and one, as large as an almond, in the brain stem. The last was situated in the lower half of the left side of the fourth ventricle and projected upward within the cavity of the ventricle, extending from the level of the fourth pair to the upper third of the pons. The left posterior longitudinal bundle was destroyed, and the right was deformed. The sixth nucleus on the left was compressed, and the radicular fibers of the facial nerve were destroyed; the median ribbon of Reil and the left pyramidal tract were deformed.

The question of supranuclear centers, first suggested by Parinaud, is discussed. The cases reported by Wernicke, Coutela, Rohmer, Marchand and Page, Achard, Bollack, van Gehuchten and others have led to the postulation of extranuclear centers in the region of the oculomotor nuclei, the corpora quadrigemina and subcortically, but they have not been demonstrated anatomically. In both of the cases reported, the anterior quadrigeminal bodies were not involved, and in one the nucleus of the sixth nerve was not damaged. Attention is called to the fact that lesions of the posterior longitudinal bundle are constantly found in these cases of functional paralysis. In both cases, the paralysis involved both voluntary and automatic reflex movements, which leads to a consideration of the localizing value of dissociated and total paralysis of the movements of laterality. These reflex movements were explained by Cantonnet and Taguet by the connections between the central sensory pathway, auditory pathway and visual sphere on the one hand, and mesencephalic coordinating centers on the other. Total paralysis would then depend on a mesencephalic lesion, and dissociated paralysis on a cortical or subcortical lesion. In hemiplegias with conjugate deviation of the eyes, automatic reflex movements persist.

Global paralysis of movements of laterality implies a mesencephalic lesion, but dissociated paralysis with persistence of automatic reflex movements does not necessarily imply a cortical lesion. The anatomy of the oculomotor pathways indicates that there is a double corticonuclear oculomotor pathway:

"1. The anterior pathway from the rolandic area goes into the internal part of the foot of the peduncle, then reaches the median ribbon of Reil, where it courses with the aberrant peduncular, pontile and bulbopontile fibers of the pyramidal tract. An oculogyric and cephalogyric pathway, which, after decussation in the median line, gives off fibers that go to the oculomotor nuclei: the third pair of both sides, the fourth pair of the same side and the sixth pair of the opposite side; to the facial and spinal nerves of the opposite side, and to the divers motor centers in the cervical cord. This is the corticonuclear pathway for voluntary motility.

"2. The posterior pathway is a long pathway from the occipital cortex; by way of the optic radiations, it reaches the anterior quadrigeminal body, where it has

a relay; then, descending into the cerebral peduncle, it gives off fibers to the third nucleus of the same side; then, decussating in the median line with its opposite fellow at the level of the fountain decussation of Meynert, it descends in the prelongitudinal bundle and supplies fibers to the fourth and sixth nuclei of the opposite side, and to the facial, spinal and cervical nuclei (cephalogyric nuclei), likewise crossed.

"Finally, there is the system of internuclear pathways of association, which renders possible motor synergies of certain muscles independently of the action of the corticonuclear connections—the posterior longitudinal bundle—which assures, for example, the synergy of the external rectus muscle of one eye and the internal rectus muscle of the other and the movements of laterality, thanks to the crossed connections between the oculomotor nuclei."

Velter believed that paralysis of voluntary associated movements with preservation of automatic reflex movements depends especially on a lesion of the posterior longitudinal bundle, and that the loss of both voluntary and reflex movements depends on an additional lesion of the reflex pathways, especially the posterior corticonuclear. Since the prelongitudinal bundle was involved in the cases reported, the corticonuclear reflex movements would be lost, but not the mesencephalic reflex movements, such as those from caloric irrigation of the ear. Therefore, there is an element in the dissociation of the paralysis of automatic reflex movements of divers sources, study of which will lead to the search for more precise localizations.

The conclusions are: 1. The postulation of supranuclear centers for coordination of the movements of laterality must be closely scrutinized. Since the anatomy of the oculomotor pathways and the internuclear pathways of association are now better known, it seems that the idea must be abandoned. 2. These observations confirm those of other writers in showing that damage of the posterior longitudinal bundle is the usual anatomic substratum for the production of Foville's syndrome. However, this lesion can explain the paralysis only if the sixth nucleus or its adjacent region plays the rôle of switchman for the association bundle.

DENNIS, Colorado Springs, Colo.

A STUDY OF THE STRUCTURE OF DEPRESSIVE STATES: THE AMBIVALENT DEPRESSIONS. E. MINKOWSKI, Schweiz. Arch. f. Neurol. u. Psychiat. **26**:230, 1930.

Minkowski expresses the belief that in the structural analytic approach to psychopathology, the study of the ideo-affective content should yield first place to that of the essential characters of the particular mental structure of the disease. The investigation of the fundamental difficulties (troubles générateurs) should concern itself with the manner, normal or pathologic, in which the personality orients itself in regard to time and space.

The first patient studied, a man, aged 26, previously healthy, had suffered for nearly a year from a severe depression characterized by inertia and almost complete inactivity. As the subject analyzed himself well, being of superior intelligence, his various complaints are reproduced in extenso. He manifested a critical attitude toward his numerous hypochondriac and cenesthopathic symptoms, and was distressed because he was preoccupied to such a degree with his material self. At the same time the patient entertained doubts in regard to his existence and questioned his right to use pronouns of the first person. He felt that when sitting he was a different person than when standing, and he expressed doubts as to the actual existence of others. He was equally distressed by feelings of being compelled to act according to the word or example of others and of being out of contact with his environment through an utter inability to render himself comprehensible to others. In his feelings and activities he was tortured by a sense of ambivalence, which he aptly contrasted with a previous contrariness that was exhibited merely to gain time for a proper analysis of what others had said ("temps de défense"). At times he was troubled by negativistic promptings. Through an absence of a proper sense of achievement, he felt unable to terminate his actions at the proper time. He also experienced a lack of the sense of the

proper sequence of acts and an incapacity to direct his activities properly. In this connection he was struck by the fact that previously unconscious mental processes had become conscious.

Under the heading of "disaggregation of the notion of time," many complaints relating to temporal orientation are recorded. As the patient expressed it, he seemed to move in a sense opposite to that of the earth. A sensation of time passing too quickly, he characterized as atrocious. He could see stationary but not moving objects, and for that reason his daily walk occasioned intense suffering. The sense of continuity was lost; each act seemed the last, and the preceding year appeared to him as a void. A new day differed in no way from the preceding days; the patient felt that he could do nothing but carry on his usual routine. Memories seemed to roll through his mind as veritable obsessions, having no reference to the present. In attempting to do anything, the mere thinking of the first act exhausted him, and he could accomplish it only through thinking of the next act to follow. Everything done by himself or others during the period of illness appeared either to have been the wrong thing to do or to have been done too late.

In his analysis of this case, the author stresses the significance of the disturbance of temporal orientation as being in essential agreement with the patient who considered himself "un malade de temps." Unless one's mental life has suffered a profound modification, every one has a particular sense of participation in the events of his environment. Each day one is attracted by that which is new and different. The ennui resulting from a monotonous existence differs from the state of mind of the patient in question, as hesitation differs from ambivalence. Normal persons regard the present as arising out of the past and the future as the product of the present, an integration that was lacking in the patient. At the base of one's consciousness of time are two elements, the one dynamic and the other, since it is static, might be designated as "the eternal." The patient in question seemed unable to unite these two factors; in the author's words, "he was unable to unite that which normally could not be disunited." This was believed to be the fundamental difficulty. The patient's inclination to attribute his malady to a conflict with his father over the matter of his independence represented the second degree of an attempt at rationalization ("travail de remplissage"), the first being the manner in which he believed he relived the past.

The matter of the consciousness of existence is considered at length, and this too is divided into two normally inseparable elements, a material and a spiritual or psychic (solidarité organopsychique"). As another instance of his morbid dualism, the patient was unable to unite these two factors. The hypochondriacal complaints were believed to be the outgrowth of this particular difficulty.

In spite of the patient's undoubted ambivalence, the author was of the opinion that the definite depression, the hypochondriacal preoccupations and the psychasthenic character of the complaints removed the case from the schizophrenic category. Furthermore, the patient made a complete recovery and did not present any schizoid characteristics at the time, although later the author noted an absence of syntonic traits in his makeup and a vague something suggesting the schizoid type. The author was also influenced in his decision by the fact that the symptoms under discussion were subjective, having been brought to light by the patient's analysis of his case, while the diagnosis of schizophrenia is usually based on objective evidence.

The second patient studied, a woman, aged 37, was more definitely schizoid, but like the first had a depression from which she recovered in the course of a year. She likewise presented the principal features of morbid dualism, of which ambivalence was but one manifestation. Disturbance of the relation of time was not an outstanding symptom in this case, and the cenesthopathic complaints were more pronounced and denoted a more profound modification of the personality. This patient complained that she seemed to enter the persons of others and that others seemed to enter her own person, and that her thoughts seemed to come from without.

In conclusion, the author remarks that the first patient approached an endogenous depression, while the second was more suggestive of a condition described by de Clérambault as "mental automatism." For this reason the two are not superposable. Nevertheless, the depressive factor and the definite ambivalence seemed of sufficient importance to justfy the use of the term "ambivalent depression."

DANIELS, Rochester, Minn.

PARALYSIS OF LATERAL MOVEMENTS OF THE EYES AND DISSOCIATED NYSTAGMUS IN MULTIPLE SCLEROSIS. P. GAUDISSART, Rev. d'oto-neuro-opht. **8**:684 (Nov.) 1930.

Sauvineau observed that paralyses of lateral movements of the eyes are not shared equally by the two eyes and that they are accompanied by either nystagmoid movements or by a true nystagmus. In 1927, Radovici and Saluvesco reported two cases in which the nystagmus was dissociated in the lateral gaze and was noted principally in the abducted eye.

Gaudissart's study of eleven cases shows: 1. The paralysis affects the adducted eye more than its congener. 2. The abducted eye most often, as soon as it passes the median line, shows nystagmoid movements, horizontal in character (this was true except in one case, in which a rotatory component was added). This nystagmus has a wide amplitude, is less regular than true nystagmus and is oscillating. The opposite eye remains immobile or, in extreme cases, has a nystagmus of small amplitude. 3. In three cases, convergence was diminished or abolished; in three, elevation of the gaze was abolished and two other cases showed vertical nystagmus when the patient looked upward.

During the evolution of the syndrome, the paralytic phenomena in the adducted eye increase and soon reach the maximum, and the nystagmus phenomena in the abducted eye become modified: while, at first, nystagmus is noted only when the eye approaches the external angle, later it occurs as soon as the eye passes the midline and increases in amplitude until the movement occupies the entire distance between the center and the angle.

Subjectively, diplopia existed only in cases that were far advanced. Half the cases showed little affection neurologically but all showed paresis, or sensory or equilibratory disturbances. In no case did ocular symptoms cause the patient to seek aid.

An interpretation of these phenomena, the most complex and least known problems of nerve physiology, requires first a summary description of the nerve centers and pathways concerned in ocular movements.

From the center of voluntary motility in the second frontal convolution, fibers go to the oculomotor nuclei of the same and of the opposite side. In one part of their course they are not a part of the pyramidal tract but follow a pathway composed of the aberrant fibers of the lemniscus. They traverse the tegmentum, are incorporated in the median ribbon of Reil, descend there and decussate incompletely at the raphe. They appear not to go directly to the oculomotor nuclei but to various intercalary systems. According to Winkler, the reticular nuclei and the adjacent part of the dorsal nuclei of the pons form the intermediate station where most of the fibers of the lemniscus terminate. From that point fibers go to the nuclei of the sixth, fourth and third nerves, via the posterior longitudinal bundle, and convey impulses for laterality, convergence and lowering and raising of the globes. This bulbopontile convergence of pathways explains how a single lesion may cause interference of function of such widely separated nuclei as the third and sixth.

The special intercalary systems for movements of laterality, convergence, raising and lowering of the globes are: (1) For movements of laterality, the nucleus of Fuse, which forms the cephalic part of the sixth nucleus and which is contiguous to the triangular nucleus of the eighth nerve. Its fibers traverse the sixth nucleus and cross to the posterior longitudinal bundle of the opposite side, through which they reach the third nucleus. (2) For movements of lowering the

globe, convergence and accommodation, the cellular masses in the median line, situated between the third and fourth nuclei. (3) For movements of raising the globe, the intercalary system composed of the nuclei of Darkschewitsch.

Reflex optic impulses of retinal or cortical origin reach the oculomotor nuclei by way of the anterior quadrigeminal bodies. The excitations from the vestibular apparatus arrive by a complicated system of pathways. The superior olivary nuclei bring them into relation with the nuclei of the eighth pair and with the anterior corpora quadrigemina. These multiple connections end in the posterior longitudinal bundle. A large part of these fibers enter it at the segment located at the pontobulbar junction. At this point the tracts are separated and it is here that dissociation of oculomotor function must be sought.

Nystagmus in associated paralysis is a central reflex and is not due to the effort of turning the eyes. It is present especially in disturbances of movements of laterality. The intervention of the vestibular system, the superior olive or the cerebellum is necessary to explain the peculiar nystagmus and a majority of the cases studied presented a disturbance of the cerebellar system.

It is impossible to designate the bundles involved. The best that can be said is that the lesion was near the midline and may have been unilateral.

DENNIS, Colorado Springs, Colo.

CHARACTERISTICS OF THE DISTRIBUTION OF DISEASES IN THE CENTRAL NERVOUS SYSTEM. P. SCHWARTZ and H. COHN, Ztschr. f. d. ges. Neurol. u. Psychiat. **126**:1, 1930.

The recent tendency in the study of the nervous system has been to emphasize the finer changes in the nerve cells and fibers. Schwartz and Cohn plead for studies that will tend to indicate the method of distribution of disease processes. These are roughly of three sorts: (1) diseases that involve the entire territory of unitary structures, such as the entire white matter of the cerebrum or the entire area of certain basal ganglia, (2) diseases in which there is only a tendency to such a distribution and (3) diseases in which there is no tendency of this sort.

Electivity of the White Matter of the Cerebrum: There are certain disease processes that cause an isolated and elective disease of the entire white matter of the cerebral hemispheres. Schwartz and Cohn were able to determine a definite, typical sort of localization, and a definite type of distribution of diseases of the cerebrum of the most varied etiology. Thus they found small pinpoint hemorrhages throughout the entire white matter of the cerebrum following treatment with arsphenamine, and in cases of anemia, cerebral trauma and grip, and in an infant, aged 2 days. In the latter, the disease was confined to the white matter and was characterized by congestion and stasis and by a diffuse softening of the white matter. Schwartz and Cohn emphasize that the exquisite electivity mentioned may be brought about by the most varied causes. It is by no means a process specific for the disease.

Elective Disease of the Cortex: The cortex may be similarily involved and may leave the white substance untouched. In a case of puerperal eclampsia there was a highly selective disease of the parietal cortex, characterized by innumerable pinpoint hemorrhages throughout the cortex. Such changes are often seen in embolic occlusions of vessels in arteriosclerotic vascular changes and in traumatic lesions. Schwartz and Cohn report a case of pneumonia with numerous pinpoint hemorrhages scattered throughout the parietal and temporal cortex, and confined to the latter. Similar changes were present in a case of apoplexy and pneumonia, and in a case of measles with otitis media and sinus thrombosis. In the latter, the cortical hemorrhages extended from the precentral convolution to the occipital pole of the right hemisphere. Schwartz and Cohn speak of a cortical distribution of lesions similar to that seen in the white matter. They did not see any cases in which the hemorrhagic lesions were spread uniformly throughout the cerebral hemispheres of both sides. They believe, however, that this is possible.

Elective Disease of the Basal Ganglia: These structures may also be involved to the exclusion of other parts of the brain. In a case of embolic disease, the anterior and lateral striatal sectors were involved by hemorrhage and softening, while the surrounding white matter was totally spared. This is an incomplete involvement, but Schwartz and Cohn have seen a completely selective bilateral involvement of the striatum by punctiform hemorrhages in venous thrombosis. The pallidum is selectively involved in poisoning with carbon monoxide. In a case of embolism of the sylvian artery, there was a hemorrhagic infarct of the lower two thirds of the anterior part of the striatum. The case is proof that purely circulatory disturbances can produce a disease of the entire striatum. There are instances in which the putamen has been involved by disease, while the pallidum has been absolutely untouched.

Electivity of Other Areas: Judging by the isolated involvement of some regions, one may speak of the independence of morphologically and functionally connected areas. Thus, Schwartz and Cohn report the isolated involvement of the gray matter around the amygdaloid nuclei, of the inferior olives, of the gray matter of the cord, of the white matter of the cerebellum, the granular layer of the cerebellum and of the dentate nuclei. All these were found involved by punctate hemorrhages in diseases of varied etiology.

Comment: Certain conclusions are possible concerning the spread of the disease process. First, it is in no way related to the intensity and duration of the causative factor. Furthermore, there is no relation between the specificity of an injury and the distribution of its effects.

The point of importance concerning the local changes described is that these changes are functional and are due to functional circulatory disturbances. The concept of these disturbances goes back to Ricker, who described, histologically, stasis, erythrodiapedesis and leukodiapedesis as stages in the development of local circulatory disturbances for which no cause, embolic or thrombotic, was demonstrable. These changes have been found by Schwartz and Cohn in their cases. They found, moreover, that the local effects caused by functional vascular disturbances could be traced to vessels lying deep in the brain and running through tissue unaffected by the vascular disturbance in function except to show dilated vessels.

ALPERS, Philadelphia.

DISORDERS IN THE DEVELOPMENT OF LANGUAGE. JACQUES LEY, J. de neurol. et de psychiat. **30**:415 (July) 1930.

Human language is defined as an ensemble of systems of conventional signs designed to express ideas. These systems in the order of their development are: mimic language, spoken language and written language. Musical language may be considered to some extent as an independent system. These systems are acquired at different periods of development, comparable to the development of certain functions, and may be classed as: motor, sensory and intellectual. Disturbances in the development of any one of these will cause a characteristic difficulty in the use of language.

Under intellectual difficulties are classified: (1) global or native deficiency, which may be congenital or acquired and is exemplified by idiocy, imbecility and other grades of feeblemindedness, and (2) elective deficiencies, which cover gnostic disturbances, difficulties in memory and attention, evolutionary alexia and agraphia and certain other neuropathic disturbances that are almost always congenital.

The sensory disorders which may alter the development of language are principally auditory, although vision may play its part.

Motor difficulties are of three types: (1) disturbances of praxic function; (2) disturbances of coordination, and (3) difficulties in the pronunciation of words as a result of peripheral or central disorders, as in stuttering, stammering and the pronunciation of certain letters.

The author believes that this classification is the best, but since it is schematic, he classifies the disturbances in succession as: (1) disorders of language without

global or native intellectual incapacity: auditory mutism, congenital word-blindness and deaf-mutism; (2) disorders of language caused by global and native intellectual incapacity: idiocy, imbecility and feeblemindedness, and (3) disorders of pronunciation in spoken language: stuttering, inability to pronounce certain letters and stammering.

Ley considers briefly the normal development of a child's speech, and points out that the child acquires first the principal vowels, then the labials and dentals, and later the palatals and gutturals. This development is followed by the formation of words and attempts at making sentences, which begin, however, before he has learned to pronounce all sounds correctly. Articulate language is considered to be a form of skilled movement that has its origin partly in visceral sensations and partly in impressions transmitted to the brain by sense organs. A disturbance of any of these steps in the normal development of language may result in a disturbance of the development of language.

Ley discusses in detail the development of difficulties in language, their pathogenesis and the treatment for them under each of the classifications cited and concludes that the difficulties in the development of language are not static, but that the symptoms change constantly because they are an expression of pathologic phenomena taking place in the process of evolution. The integration of language is not an independent psychic process; it is grouped with automatic or voluntary motor activity and with functions of the brain in general.

The consciousness of one's own existence and of that of the outside world is a result of the repetition of instinctive movements, such as crying, breathing, swallowing, etc., which accompany sensations and develop in one the first phenomena of perception. No perception would occur if it did not give rise to a motor reaction. Thus, motor experiences tend to be preserved and to be imitated. One understands them because he imitates them, and thus imitation of fixed gestures is the basis of the first phenomenon of mind. One arrives at consciousness, mind and language by reacting to one's own instinctive actions.

There is no language without thought, and very little thought without language. If oral language is not developed normally, thought remains rudimentary, and can never approach abstraction.

Disturbances that may hinder the normal development of language never affect electively and solely the function of thought, which is disturbed only by the different forms of auditory and visual agnosia. Difficulty in the integration of written language is much more elective than oral language, since it represents a higher level — the graphic representation of oral language. This then brings two factors into consideration.

The author observes that all forms of difficulty in the development of language occur much more frequently in males than in females. He does not offer a satisfactory explanation for this phenomenon.

WAGGONER, Ann Arbor, Mich.

GRADENIGO'S SYNDROME: ANATOMIC ASPECTS. PHILIP E. MELTZER, Arch. Otolaryng. **13**:87 (Jan.) 1931.

Gradenigo's syndrome consists of: (*a*) abducens paresis or paralysis, (*b*) severe pain in one or more areas in the distribution of the trigeminal nerve, but most commonly localized in the temporoparietal region, in the eye or deep in the orbit and (*c*) an acute suppurative otitis media, with or without perforation of the membrana tympani. The reason is an otitis extending to the tip of the petrous bone, where it produces a circumscribed osteitis, which in turn causes a localized meningitis. Meltzer proposes to investigate whether this is the only method by which the inflammatory process or toxin may extend, and whether a meningitis needs always be present to explain the symptoms.

A description of the anatomy is given, with special attention to the petrosphenoidal ligament and the deep sulcus for the inferior petrosal sinus, with their influence on compression of the sixth nerve. The large pneumatic cells are fre-

quently found at the tip of the petrous bone, although diploic cells are present in the majority. At times the tip is either cancellous or dense.

Dorello's canal is described. A delicate connective tissue was usually found about the nerves, which the author believes would always be present in freshly prepared specimens. This is of importance as, according to the theory of Papale, it is at this point that inflammation or toxins are diffused to the surrounding nerves. A description of the blood vessels, lymphatics and tissue spaces, as viewed by recent authors, is given, together with a detailed description of the course of the sixth nerve. Attention is called to the relationship of the fifth nerve, the sympathetic plexus of the carotid, the lesser superficial nerve and the otic ganglion.

It has been considered that the disease spreads through large pneumatic cells when present, through a diffused osteitis in a diploic bone or through an inflammatory edema at the tip with a periosteitis of the bone without an actual inflammation of the meninges. However, the author inclines to the belief that the nerve is usually affected by toxemia, either produced in loco, or coming through the carotid tympanic and pericarotid lymphatics. The fifth nerve is more irritable than other nerves; the pain is not necessarily due to an actual primary involvement of the ganglion for the following reasons: (*a*) It is generally accepted that painful impulses are carried along sympathetic nerves to peripheral nerves and localized at an area not contiguous to the part affected. A glance at the sympathetic connections with the fifth nerve in this region might be a possible explanation of the pain. (*b*) The pain could be due to increased pressure in the cells at the apex and in themselves give rise to a pain reaction which is localized deep in the orbit or temporoparietal region. It is not an easy matter for children or even adults to localize deep-seated pain in this region. (*c*) It is possible that pain may be carried to adjacent sensory ganglions and then transferred from the sensory filaments of the neuron primarily involved and even to those of the secondary neuron. The stimulus is then carried in this neuronic pathway to the brain and is perceived as coming from the distribution area of the secondary neuron. This is called reflex or reflected pain. When one considers the ganglion connections with the nerves passing through the middle ear, it seems evident that there is something in the theory of reflected pain that may offer ample reason to explain the pain in the Gradenigo syndrome by these connections. It is known that the probable cause of deferred pain is a lesion somewhere in the nerve circuit, either in the nerve trunk or in one of its branches. The term pain is used in its broadest sense.

The author concludes: "Gradenigo's syndrome may be due to: (*a*) cells extending to the apex (paralabyrinthine, subarcuate, paratubal), (*b*) the carotid canal (caroticotympanici canals, canaliculus tympanici), by erosion of the bone wall of the eustachian tube, (*c*) the perineural and perivascular lymphatics of Papale, (*d*) erosion of the tegmen tympani with extension forward and (*e*) the inferior and superior petrosal sinus."

HUNTER, Philadelphia.

CERTAIN REFLEXES, ESPECIALLY THE OCULOCARDIAC REFLEX AND PROVOKED NYSTAGMUS, IN A CASE OF PATHOLOGIC SLEEP. J.-A. BARRÉ, METZGER and KUHLMANN, Rev. d'oto-neuro-opht. **8**:747 (Dec.) 1930.

The various types of toxins, perhaps each toxin or even each dose, may cause varied clinical pictures, in which certain reflexes are markedly affected and others are not. Few researches have been made on the effects of intoxications in man. The text for this article is the case of a woman, aged 20, who was brought to the hospital in an unconscious condition, having swallowed a large dose of a derivative of allyl-isopropyl barbituric acid a few hours previously. The neck was slightly stiff. The pupils were equal and dilated, and they reacted to light. Firm pressure on the globe for three fourths of a minute caused no slowing of the pulse, but ten seconds later the rate rose from 80 to 115 per minute, and the patient vomited. At this time the corneal reflex was temporarily present. All cutaneous and tendon reflexes were normal and lively. The eyes were immobile

and looking straight forward. The ears were irrigated with water at 27 C. After 100 cc. in the right ear there was a slow movement of the eyes to the right palpebral angle, where they remained until the irrigation was stopped and then returned slowly to the central position. After 70 cc. had been syringed in the left ear, the eyes slowly turned to the left angle and remained there one hundred and ten seconds after cessation of the flow and then returned to the central position.

Thirty hours after the poisoning, signs of returning consciousness began to appear and all the reflexes returned to normal, including the oculocardiac, but there was no change in the vestibular reactions. In the galvanic test, the thresholds were equal on the two sides; with 1.5 milliamperes there was a slow displacement of the eyes toward the positive pole. Six hours later, slight nystagmus was produced by the current, but there was no nystagmus from caloric stimulation until the third day. At this time, during irrigation of the ear, when the patient attempted to look to the left, the right eye did not pass the median line. Recovery was complete on the sixth day; nystagmus occurred after 25 cc. of water had been injected; rotation produced nystagmus, lasting twenty-five seconds, and the threshold for the galvanic current was 0.5 milliampere.

It is interesting that the tendon and cutaneous reflexes were present while certain bulbar reflexes were markedly modified. The oculocardiac reflex pathway is by way of the sympathetic and vagus nerves. The effect produced by this test in this case is thought to be the expression of a sympathetic reaction (sympathetico-sympathetic), the sympatheticovagal being abolished, and the pupillary modifications tend to confirm this idea. To be noted in the vestibular reactions are: (*a*) elevation of the thresholds of reaction; (*b*) lack of conformity in the thresholds for the caloric and galvanic reactions; (*c*) replacement of the slow component of nystagmus by a very slow movement and the lack of the quick phase; (*d*) disturbance of associated ocular movements during vestibular stimulation. "The disappearance of the rapid phase appears to be a test of sensibility great enough to indicate the degree of intoxication." Study of the effects of other poisons on the reflexes will probably show a symptom-complex peculiar to each poison.

In the discussion of this paper, de No made the point that, while the cerebral cortex and the thalamus were not necessary for the production of the quick phase of nystagmus, there is a point in the brain stem where the regulating system for ocular movements is joined by the oculomotor nuclei; if this point is destroyed, the rapid component of nystagmus is lost. He also referred to the fact that in rabbits under ether narcosis the tonic reflexes on the eyes first disappear; then, when the corneal reflex is gone, the quick component of nystagmus is lost also, and it is only under very deep narcosis that the slow phase of nystagmus is abolished—a chain of events like that in the case reported.

DENNIS, Colorado Springs, Colo.

THE PSYCHOSES IN THE CLIMACTERIC AND INVOLUTIONAL PERIODS. ERICH JACOBI, Arch. f. Psychiat. **90**:595, 1930.

The author reports the results of a thorough investigation of more than 200 cases of psychoses occurring in women at the climacteric and the involutional periods of life. The patients were admitted to the clinic during the two years and four months of the study and formed 12.5 per cent of the total number of women patients admitted. Following a discussion of the literature, in which it is pointed out that the concepts of the climacterium and involution as special stages in human life as well as the occurrence of special types of psychoses in these periods are not at all universally agreed on. The author is of the opinion that the best definition of these two periods of life is the one advanced by Kehrer. The latter regards the climacterium as the "isolated involution of the sex organs," that is, the phase of transformation into an indifferent stage. By involution is meant the actual change of the function-bearing cerebral tissues. From a practical point of view, however, seeing that chronologically these two stages, even if

they do not coincide, usually overlap each other to a certain extent, one can discuss both periods under the same heading.

In his investigation the author was particularly concerned with the question of the existence of specific types of psychoses at this age. A general classification brings out the following groups: (1) depressions, (2) paranoid states, (3) schizophrenic processes and (4) psychogenic reactions. Statistically, all of these are represented well, even if not equally, in the material studied by the author. Therefore, it would seem that one cannot speak of one special predominating type of psychosis belonging to this stage. The different types, however, differ from one another in the fact that some seem to occur only in this period of life, whereas others do not show any essential difference from similar psychoses encountered in other periods of life.

In studying the psychoses, it becomes especially evident that the climacterium and involution are periods in which a more pronounced leaning toward mental disease is found. This is probably to be explained by the facts that there are here: (1) radical changes of a physical nature, such as of the endocrine organs, the central nervous system, etc.; (2) adjustment to an abrupt cessation of an emotional factor that had been hitherto an important component in the personality.

In practically all the mental diseases occurring at this age there are certain common factors that are apparently connected with the changes occurring at this time. The most important of these are fear and hypochondria. Although all the other symptoms differ in the different disease processes, a great many of them can be understood on the basis of the previous personality and conflicts, the adjustment to new interests, the loss of others, and other factors of importance at this stage. Of the disease entities enumerated, the most frequently encountered are the melancholias and the paranoias. The melancholias or depressions of this period belong to a type that may be considered as a disease limited to this stage of life. The paranoias, however, although showing certain peculiarities and differences from similar diseases occurring in other periods of life, still cannot claim a special place in psychiatric nosology. Of the less frequent types, the so-called "late catatonia" seems to be particularly limited to this age. It has a symptomatology and course that are not encountered at any other stage of life. In considering the etiology and mechanisms of these psychoses one has to take into account also the influence of heredity and environmental stress and strain. It was found that women who are either unmarried or widowed have a greater leaning toward psychoses at this period of life.

It must be stressed that the climacterium and involution should be considered in most cases as only a precipitating and reinforcing cause and not as a primary one. In some cases, however, especially in those that belong to "late catatonia," it is conceivable that some hitherto undetermined pathologic process in the central nervous system is the important cause.

MALAMUD, Iowa City.

VON GRAEFE'S SIGN, A SYMPTOM OF CEREBRAL LOCALIZATION. P. GAUDISSART and L. LARUELLE, Rev. d'oto-neuro-opht. **8**:693 (Nov.) 1930.

Von Graefe's sign and Stellwag's sign are a part of the classic picture of exophthalmic goiter, but their presence in cases of cerebral tumor is rare.

A man, aged 33, for the preceding year had had visual difficulties and headaches, and latterly had become stuporous. Examination revealed papillary stasis, apparent exophthalmos and lagging of the upper lid on looking downward. Measurements with the exophthalmometer showed that there was practically no exophthalmos, and it was to the abnormal palpebral motility that the appearance of exophthalmos was due. On looking downward, the lids at first were elevated; they remained in this position an instant and then followed the globe downward. On looking upward, the right eye barely passed the horizontal level; the left eye did not pass it and was turned inward; convergence was abolished. At times, attacks of vertigo had occurred, and there were disturbances of the sympathetic system: excess of tears and sweating. The deep reflexes of the trunk, head and

limbs were exaggerated. The cutaneous reflexes were present, and sensation was normal. The associated movements of the trunk, head and neck were abnormal, spontaneous during walking, and while sitting, they could be provoked by straightening the spine. If the trunk was straightened by pressure over the upper dorsal section of the spine, the neck was extended, the chin pointing upward and forward.

The several interpretations of anomalies of motility of the lids in cases of exophthalmic goiter are discussed, and the conclusion is reached that hypertonia of the striated fibers of the levators is the most satisfactory explanation. This hypertonia can theoretically be caused by: (*a*) hyperinnervation of the levators in paresis of the elevators of the globe, (*b*) a slight involvement (irritative) of the nuclei of the levators and (*c*) damage of the extrapyramidal system. The last condition was present in the case reported. In animals, Magnus has shown that there is a group of reflexes that controls the position of the head, trunk and limbs in space and in relation to each other. In this patient, the reflexes were put in evidence by a veritable hypertonus of the erector muscles of the head, neck and trunk, resulting in a "hypersynergy of station." Physiology demonstrates the reflex connection between movements of flexion and extension of the head, vertical movements of the ocular globes and movements of raising and lowering the lids. The coexistence of these exaggerated reflexes of the spinal column, with exaggeration of the tendon reflexes, is remarkable. This first relay is constituted by the proprioceptive nerves of the back and neck, the column of Clarke and Monakow's nucleus, with reflexion of the nervous impulse at the red nucleus. A liberation of the latter by a lesion above it would explain this hyperreflectivity. It would represent a sort of decerebration phenomenon and would point to a localization in the diencephalomesencephalic region, as would also the ocular palsies.

Only four similar cases were found in the literature; this is the first one, however, in which von Graefe's sign could be satisfactorily interpreted, owing to the close cooperation of the oculist and neurologist.

Recent studies of the paralysis of upward movement of the globes and lids tend to a revision of the belief that it is due to a lesion of the quadrigeminal bodies. Dereux believed that the lesion is in the vicinity of the thalamic region, and a system of commissural fibers going between the optic formations of the two sides can explain the paralysis, even in unilateral lesions. Oljenik considered the two nuclei of Darkschewitsch as the intercalated system of the elevators of the gaze. These nuclei receive the fibers of the posterior longitudinal bundle, and each sends fibers to the nucleus of the opposite side via the posterior white commissure. Whether one follows Dereux or Oljenik in their interpretations of Parinaud's syndrome, the localization—the diencephalomesencephalic region—remains the same.

DENNIS, Colorado Springs, Colo.

A CASE STUDY IN DEAF-BLINDNESS. RALPH V. MERRY, J. Abnorm. Psychol. **25**:133 (July-Sept.) 1930.

Merry refers first to the successful training of Laura Bridgman by Dr. S. G. Howe and to the later and more brilliant achievements of Helen Keller under the teaching of Miss Sullivan as demonstrating that, barring coincidence of mental deficiency, the deaf-blind are educable and may reach a high intellectual level if proper educational opportunities are available. The deaf-blind require an infinite amount of patience and resourcefulness and a large measure of individual attention to reach the maximum development. Merry deplores the fact that recently there has been a tendency to give up the individual case method employed in the training of Laura Bridgman and Helen Keller, and an inclination to distribute the few deaf-blind children of school age among institutions for the blind and institutions for the deaf. This, he believes, is unfair both to the institutions concerned and to the children, since the latter belong neither to one group nor to the other and under such training will probably not become adjusted either educationally or socially.

He believes that deafness constitutes a more serious social and educational handicap than blindness.

Merry gives in detail the history of a deaf-blind boy who lost sight and hearing at the beginning of his twelfth year, having previously made a school record which was probably somewhat below the average for his age. He outlines the difficulties that were encountered in the psychologic and psychometric examinations of this boy, and points out the defects of the present tests when applied to the deaf-blind. He then outlines some details of the education and training that were applied in this case, and reaches the following conclusions, which affect the treatment of the deaf-blind in general:

1. The individual case method of approach is probably superior to any other in dealing with the deaf-blind. All facts concerning the person should be gathered and interpreted before inferences regarding his capacities are drawn and a course of treatment adopted.

2. It is practically impossible to obtain a quantitative estimate of the intelligence of such a person by means of any existing measurements. Yearly scales such as the Stanford-Binet scales are unsuitable, since in few, if any, instances can all the tests assigned to a particular yearly group be used. Furthermore, the method of scoring makes no allowance for marginal errors, which are of importance in a case of this sort. Tests of performance would probably serve as the most accurate means of judging the intelligence of the deaf-blind if restandardization of the element of time could be effected.

3. While it may be impossible to obtain a quantitative score, a qualitative study of test results will indicate with some accuracy whether the person in question is of good native intelligence, and will also give the approximate extent of his retardation.

4. It seems probable that the deafness of a deaf-blind person is responsible for a greater share of his mental retardation than is his blindness. Serious dearth of vocabulary and awkwardness in use of language, which are found more commonly among deaf than among blind persons, would seem to bear out this fact.

5. If suitable methods are employed and no native mental defect coexists with the sensory deprivation, there is no reason why a deaf-blind person is not educable. Undoubtedly, a late adventitious case, such as that described in the present study, is a simpler problem than cases of an earlier adventitious or congenital nature. Even these, however, should respond to intensive educational methods, although probably to a lesser extent.

WILLEY, Harrisburg.

A CLINICOPATHOLOGIC STUDY OF PICK'S ATROPHY. LUDWIG HORN and ERWIN STENGEL, Ztschr. f. d. ges. Neurol. u. Psychiat. **128**:673, 1930.

Richter first recognized that Pick's atrophy is a disease *sui generis*. Pick thought that it was a form of senile disease of the brain. Richter considered it to be one of the heredodegenerative diseases of the nervous system (Schaffer), and Gans concurred in this. Gans believed that the disease picked out phylogenetically younger parts of the nervous system and was limited to certain cyto-architectonic areas, the frontal and the temporal. Altman later called attention to the close relation of Pick's atrophy to cases of senile dementia without plaques and the fibrillar changes in the vessels. Ouari and Spatz, however, separated the disease from senile dementia. They found that the disease was characterized by atrophy, which was limited to a cyto-architectonic complex, by a loss of cells in the first three layers of the cortex and by the lack of vessel sprouts, inflammatory changes, senile plaques and fibrillary changes. Keefs found mild inflammatory changes in the atrophic parts and also senile plaques. Braunmühl found plaques in one of his specimens and concluded that Pick's atrophy could occur both with and without plaques.

Horn and Stengel found two cases of Pick's original cases and two cases of Pick's disease described by Pötzl with localized atrophy in the occipital lobes. They report a case, with necropsy, of localized atrophy of the occipital lobe, with many

senile plaques, Alzheimer's fibrillary changes, shrinkage and swelling of the cells, proliferation of astrocytes and some deposit of iron pigment. These changes were less pronounced in the calcarine than in other areas of the occipital lobe. The rest of the brain also showed senile plaques. The less pronounced involvement of the area striata, as in their case, has been reported by others in senile dementia. Marinesco and Minea found the area striata uninvolved by senile plaques, while the areas around were saturated with them. Horn and Stengel point out that the areas of predilection of Pick's disease are the areas of predilection in senile dementia and in dementia paralytica, i. e., the association fields of the brain. In their case there was diffuse disease of cells in the lateral geniculate bodies and in the thalamus and pallidum. These changes have recently been emphasized as being characteristic of Pick's disease, but Horn and Stengel point out that they occur also in senile disease. Their case differs from the usual senile dementias only by the presence of more marked atrophy in the occipital lobe. They point out that there are transitions between certain forms of Alzheimer's disease and Pick's atrophy. Grünthal has shown that the occipital lobe is often involved in Alzheimer's disease.

Horn and Stengel believe that Pick's atrophy is merely a form of senile dementia, and that there is no clinical or pathologic evidence to make it a separate entity. They divide the cases of Pick's atrophy into: (1) those without plaques and (2) those with plaques. The cases without plaques are the more numerous. It seems as if senile dementia without plaques has a greater tendency to the presence of circumscribed atrophy. This is because in this form of senile disease there is a greater loss of cells, and therefore atrophy, than in the form with plaques. The cases without plaques have a frontotemporal localization, while those with plaques are fronto-occipital, with the latter more involved. Moreover, the cases without plaques, are of several years' duration. The cases with plaques belong to the presbyophrenic types of senile dementia, with psychomotor excitement, deliria and a short clinical course.

ALPERS, Philadelphia.

LANDRY'S PARALYSIS: A CLINICAL AND PATHOLOGICAL STUDY. F. GOLDBY, J. Neurol. & Psychopath. **11**:1 (July) 1930.

A diagnosis of Landry's paralysis rests on a rather unsatisfactory and variable group of symptoms and physical signs. The essentials of this complex in its typical form are: an acute or subacute paralysis of the lower motor neuron type, ascending from the feet and symmetrically involving both sides of the body; absence of objective sensory disturbance; no dysfunction of the bladder or the rectal sphincter; little if any febrile reaction, and no considerable muscular atrophy. The common end-result is death due to paralysis of the motor nuclei in the posterior hind brain.

The author analyzes fifty-two case reports collected from the literature; he describes three new cases, in two of which there were postmortem examinations. Autopsy was done in the hope of answering the question as to whether Landry's paralysis is a disease entity with a uniform etiology, symptomatology and pathology. Three groups are distinguished.

Group 1 contains cases showing an acute ascending paralysis with little or no febrile reaction and a remarkable slightness of any changes at postmortem examinations. Chromatolysis, more or less advanced, occasionally was found in the nerve cells of the spinal cord, but this the author agrees is not specific and may result after any profound toxemia. Furthermore, it is certain that this change is not associated with any functional loss. There were eleven patients in this group, four of whom recovered. Ninety per cent of the patients were males. The age incidence lay between 10 and 60 years, with some preponderance between the ages of 20 and 30. The duration of the illness in the fatal cases varied between four and forty-days.

Group 2 comprises cases in which there is an acute ascending paralysis, frequently associated with sensory changes suggesting peripheral neuritis. There

were signs of a general toxemia without a marked febrile reaction. The postmortem observations, although variable, showed both parenchymatous and interstitial changes in the spinal cord and the peripheral nerves. These varied from chromatolysis of the nerve cells of the cord, combined with more or less parenchymatous degeneration in the peripheral nerves, to advanced degenerative changes in the nerve cells, degeneration in the tracts, perivascular infiltration of round cells and, in the peripheral nerves, marked parenchymatous and interstitial changes. Twenty cases of this type were found, among which nine patients recovered. The age incidence was between 5 and 60 years, but with an average of 28 years. Women constituted only 20 per cent of the patients. In the fatal cases the duration of the disease varied between four and forty-two days.

Group 3 shows an acute ascending paralysis, preceded and accompanied by an acute febrile illness in which sphincter disturbance is relatively frequent. There are ten cases in this group, among which two patients recovered. The age incidence varied between 10 and 30 years. There were no females in the series. Only two postmortem examinations were made; both showed changes resembling those of anterior poliomyelitis.

Goldby's conclusion is that Landry's paralysis is a syndrome caused probably by a toxin exerting its influence through the blood stream, and is more or less closely related, on the one hand, to a group of cases that are a variety of multiple neuritis, and on the other, to a group that can best be described as cases of infective poliomyelitis.

BECK, Buffalo.

FACIAL TIC IN HEPATOLENTICULAR DEGENERATION WITH SEVERE SECONDARY ANEMIA RESEMBLING PERNICIOUS ANEMIA. A. WERTHEMANN and H. WERTHEMANN, Ztschr. f. d. ges. Neurol. u. Psychiat. **126**:758, 1930.

The Werthemanns report a case of hepatolenticular degeneration in a man, aged 57, in whom during the last six years of life a facial tic developed involving the entire right side of the face, but particularly its lower portion. In addition, he suffered from cirrhosis of the liver and severe epistaxis, and from a severe anemia that appeared to be like pernicious anemia. Shortly before death, mental symptoms developed that were characterized by confusion, irritability, facetiousness and confabulation, suggestive of a Korsakoff psychosis. A fine tremor of the arms also developed, and shortly before death, hypertonia of all the extremities. The blood picture gave a color index of 1.1, with hemoglobin, 34 per cent, and erythrocytes, 1,546,000.

In the basal ganglia on both sides were numerous perivascular areas of softening, without inflammatory reaction, and in the left putamen there was a rather large area of softening. The glia cells were much enlarged. In the left thalamus there was a small area of softening, and in the right thalamus, a similar area. The right internal capsule had two areas of softening. The facial nerve was normal. The liver showed an atrophic cirrhosis with fatty degeneration and hemosiderosis.

The question arises whether the tic can be explained by the changes in the basal ganglia. Pathologic studies of tics are few. The present concept is that tics are due to striatal disease. A case was reported by Jakob of a patient with a right facial tic, who showed a general cerebral arteriosclerosis and a cystic area of softening in the ventro-oral part of the head of the nucleus caudatus bordering on the lateral ventricle. These observations have been substantiated by C. and O. Vogt and by Mingazzini. The conclusion is open to the objection, however, that cases of cerebral arteriosclerosis are often accompanied by areas of softening that have given rise to no apparent clinical signs. Changes in the basal ganglia were present in the lenticular nuclei of both sides in the case reported by the Werthemanns, and they ascribe the facial tic to these changes.

Severe tremors often dominate the picture in Wilson's disease, but ticlike movements have been described in only one case reported by Wimmer. The hypertonia characteristic of Wilson's disease was lacking in the Werthemann

case, and occurred only shortly before death. Equilibratory disturbances, so characteristic of Wilson's disease, were likewise lacking. The mental picture in this disease has been variously described as a slowly progressive dementia, decrease in intelligence, catatonia and depression, and other states.

The anemia in this case is explained on the basis of a loss of blood secondary to the cirrhosis of the liver.

ALPERS, Philadelphia.

REACTION TYPES IN INTOXICATION. F. KANT, Arch. f. Psychiat. **91**:694, 1930.

The origin of mental symptoms manifested in intoxications has always been a matter of dispute. Some authors regarded them as being directly due to the specific actions of certain agents on the central nervous system and would go so far even as to assume that different agents can cause characteristic mental pictures. Other authors, taking the opposite extreme, believed that the toxins causing the reaction had no specific characteristics, but that the picture depended entirely on the personality of the patient.

The author studied the effects of hasheesh on persons suffering with mental disease. Nineteen female patients were used, nine of them having manic-depressive and ten schizophrenic psychoses. The experiments were undertaken at a time when the patients were free from acute symptoms. Care was taken to select patients in whom physical and mental characteristics were in keeping with the form of psychosis that they showed. All of the manic-depressive patients were of a pyknic type and in selecting the schizophrenic patients all pyknic types were excluded. The patients were given from 6 to 9 Gm. of *Cannabis indica*.

In analyzing and discussing the reactions shown, the author emphasizes two important factors: 1. The pathologic mental states produced by the drug seemed to bear a definite relationship to the personality of the patients, to the conflicts that were in the foreground in the psychoses and to the symptoms shown during the acute stages of the psychosis. 2. Although certain symptoms observed in these patients were similar to those shown by normal persons under the effects of this drug, there were other symptoms that differed distinctly from them. For instance, in normal persons usually only visual hallucinations develop, whereas in the schizophrenic patients there were some auditory hallucinations.

The whole attitude of the patients to the experiment following the administration of the drug was characteristic. The schizophrenic patients were suspicious and apprehensive, and expressed ideas of persecution and fear of influence even before the occurrence of the hallucinations. In the manic-depressive cases, there was a predominance of apprehensive depression.

With Stertz, the author thinks that the mental symptoms manifested in intoxications must be regarded as consisting of two groups: (1) obligatory or fundamental; (2) facultative or accessory. The obligatory symptoms occur in all cases of intoxication, in normal as well as in abnormal people. The amnesia, the clouding of consciousness and the predominance of visual sense deceptions may be regarded as obligatory symptoms, whereas the content of the hallucinations, their relationship to paranoid ideas, and the attitude of the person to the whole situation should be regarded as accessory, and the origin of the hallucinations must be looked for in the personality and in special conflicts of the person.

MALAMUD, Iowa City.

THE CRANIOPHARYNGEAL POUCH TUMORS. A. J. MCLEAN, Ztschr. f. d. ges. Neurol. u. Psychiat. **126**:639, 1930.

McLean discusses the craniopharyngeal pouch tumors from the standpoints of embryology, histology, diagnosis and therapy. A craniopharyngeal pouch tumor is a solid mass of proliferating, stratified and polygonal epithelium in the vicinity of the sella turcica. As a rule, it compresses the hypophysis or the hypophyseal stalk. Often it spreads upward through the diaphragm of the sella, following the foramen of the infundibulum or producing a disappearance of the roof of the sella.

Depending on the richness of the blood supply, the mass may remain solid for its entire life or it may contain numerous cysts. The tendency to the formation of cysts has led to the designation "suprasellar cysts" or "Rathke pouch cysts." They may attain a huge size. Because of this tendency to the formation of cysts, they are amenable to operative treatment. They occur in children or in early youth and rarely manifest their presence in more advanced age. The fluid content of the cysts is highly characteristic: high viscosity, with numerous small cholesterol crystals floating on the surface, the color varying from a cloudy brown to an opaque dark green like motor oil. In addition to the cystic formation, the cells of the Rathke tumors often undergo hyaline degeneration. This leads to calcification, which is particularly characteristic of these tumors. The x-ray picture often shows a calcium line, and in some instances the entire tumor may be calcified. Suprasellar calcification is found in 85 per cent of the cases by roentgen examination. The tumor is not infiltrating, but by its extent and size often compresses the structures at the base of the brain.

The tumor occurs in adolescence. The chief symptoms are endocrine disorders, particularly diabetes insipidus, primary optic atrophy, bitemporal hemianopia, later choked disks and suprasellar calcification, which is seen in 85 per cent of the cases in the presence of an intact sella and somewhat eroded posterior clinoids. Any suprasellar calcification seen by roentgen examination in the presence of a normal sella, optic atrophy and any form of hemianopic field defect is extremely suggestive of the presence of a Rathke pouch tumor. The chromophobe adenomas, on the other hand, are characterized by decreased metabolism, no diabetes insipidus as a rule, and no calcification. They show the balloon-like enlargement of the sella. The meningiomas of the tuberculum sellae are found in adults and are accompanied practically constantly by primary optic atrophy and slowly progressing bitemporal hemianopia, and by normal sellae and clinoids. Gliomas of the chiasm occur in children chiefly. Vision is rapidly lost, without any specific form of hemianopia. The defects of the visual field are asymmetrical and irregular. The optic foramen may show a widening of one side, and the sella as seen from the side appears stretched out, a typical hour-glass sella.

The treatment is surgical, and the approach is always intracranial rather than transsphenoidal.

ALPERS, Philadelphia.

THE INTRATRACT FIBERS AND THE FUNCTION-BEARING SYSTEMS OF THE FLOOR OF THE THIRD VENTRICLE. B. KLOSSOWSKY, Arch. f. Psychiat. **91**:37, 1930.

Investigations were carried out for the purpose of verifying the existence and function of some of the tracts connected with the optic system and especially of the following: (1) the Ganser commissure, (2) the commissure of Meynert, (3) the commissure of Gudden and (4) the commissura intratractalis. These investigations were carried out on the following animals: in puppies and kittens whose eyes had been enucleated on the first day after birth; in kittens whose eyes had been removed three months after birth; in rabbits that had been treated in the same way at the age of 2 months, and in adult rats that had also been treated in this way. The animals were subsequently killed, and the structures to be examined fixed and stained according to the methods of Marchi and Weigert and Kultschitzki. Some of the sections were also stained for the study of the myelinization of the fibers, and finally one series was stained with osmium.

The author discusses the literature on the subject, especially in relation to the controversy as to the existence of the commissure of Gudden and whether it and that of Meynert are not really one and the same tract. The conclusions are:

The commissure of Ganser consists of thick fibers, coming from the region of the pons, along the floor of the third ventricle; then it crosses to the opposite side into the thalamic reticular zone which surrounds the external geniculate body on the ventral and lateral sides and ends there. It is not in the strict sense of the word a commissure, but should be regarded as consisting of projection fibers; it should be called the decussating tract of Ganser.

The commissure of Meynert, consisting of fine fibers, can be most easily observed on the ventral surface of the pes pedunculi. It goes through a special bundle lying dorsal to the chiasma, crosses to the other side, at first in the same position but later assuming a more lateral direction, and ends in the corpus luysii or in its immediate neighborhood. The origin of this bundle could not be definitely established by the author, but according to some observers it begins in the pons.

The commissure of Gudden also consists of fine fibers and, because of that, is not easy to distinguish from the commissure of Meynert. Still, it is distinct and can be easily followed. It proceeds from that region of the pes pedunculi which lies ventral to the medial geniculate body, goes through the posterior part of the chiasma and crosses to the ventral surface of the internal geniculate body of the other side.

The intratractal commissure, which is described by the author, consists of thick fibers coming out of the inside of the one tract, goes through the dorsal part of the chiasma into the other tract and ends in the external geniculate body.

Thus, these observations suggest that a definite distinction is to be made between the Gudden and the Meynert commissures. Little is known about the functions of either the Ganser or the Meynert fibers. The commissure of Gudden apparently serves the purpose of uniting the two internal geniculate bodies and probably has some relationship to the function of hearing.

MALAMUD, Iowa City.

WEAKNESS OF ACCOMMODATION. NICHOLAS BLATT, Arch. Ophth. **5**:362 (March) 1931.

The normal accommodation in an eye, as the author states, still seems to depend on the theory that Helmholtz set up so definitely. He continues: "The theory of Helmholtz alone explains the many paralyses and pareses of accommodation frequently met with in clinical pathology." He, naturally, excludes therefrom any accommodative deficiency due to alterations of the lens or to changes in the refractive index resulting from colloido-osmotic disturbances.

The author continues by a discussion of a relationship that exists between paresis of the ciliary body and paresis of accommodation; between weakness of accommodation and paresis of accommodation, and between the amount of accommodation used and the part that is kept in reserve. He discusses briefly the symptoms that are presented, as a result of this relationship, in weakness of accommodation, as compared to those which appear in paresis of accommodation. Under weakness of accommodation, he recognizes two forms: (1) a form in which with repeated examinations there is continued recession of the near point, and following a period of rest the near point returns to the first position observed; (2) a form in which there is a retardation of the act of accommodation either alone or in conjunction with the preceding form. The author has noticed the behavior of the pupillary reactions and the effect of cocainization on accommodation, concerning which he states: "It is so characteristic in various cases of weakness of accommodation as to become of pathognomonic importance." Bilateral weakness of accommodation is usual. An unequal accommodation of both eyes, i. e., a kind of aniso-accommodation is extremely rare in weakness of accommodation, though it is frequently seen in paresis of accommodation.

In the author's studies on weakness of accommodation he has devised an accommodatometer, based on the lines of experimentation adopted by Landolt's ophthalmodynamometer. A detailed description of the instrument and of the technic of its use is given. Working with this apparatus, he presents a series of various pathologic conditions in which the accommodation was studied. These clinical cases included different types of infectious febrile conditions, disturbances of metabolism, various toxic states, cases of convalescence from epidemic encephalitis, states of exhaustion, various somatic endocrinologic alterations, etc.

The author discusses also the pathology of the ciliary body and calls attention to the possibility of an accommodative center existing in the brain. This opinion is based on the various disturbances of accommodation seen, the action of blood-

borne toxins, and other etiologic factors concerned. He closes with a statement that the study of accommodation should be given more attention in clinics and in practice, and that more adequate and more adjustable apparatus than that in common use is necessary.

SPAETH, Philadelphia.

STUDY OF THE HEPATIC FUNCTION IN AMENTIA AND DEMENTIA PRAECOX. S. GULLOTTA, Riv. di pat. nerv. **34**:852, 1930.

The author reviews the various contributions that have been made concerning hepatic function in cases of dementia praecox and amentia in the sense of "frenosi sensoria hallucinatoria," and recalls that the presence of urobilin and other biliary pigments has already been used by numerous authors, among whom are Mongeri, Butenko, Neustadt, Schrijver and Buchler. Study of the hepatic function has also been made through an investigation of the metabolism of carbohydrates (Duse, Muggia, Ehrenberg and others). The study of acetonuria has always been used to study hepatic insufficiency, and recently the nitrate metabolism has been taken into account by Claude and Blanchetiere, Otonello and Debeuz, Uyematsu and Soda, McIntyre and others.

Gullotta studied the hepatic function through the chromogenic function of the organ with the rose bengal method of Fiessinger and Walter, and added to this test a study of the pigments of the liver. In order to exclude the supposition that the increase in pigment in the blood might be the result of hemolitic processes, the author studied the globular resistance of the blood. The conclusions from his work are that in cases of amentia and dementia praecox there were no changes in the globular resistance of the red elements. In the twelve cases of amentia that the author investigated, he found an increased retention of rose bengal in the blood and aromatemia as detected by the positive reaction of Machold and Andrewes and the xanthoprotein reaction. He also found an increase of the indirect diazo-reaction to the van den Bergh test, whereas, bilirubin was within normal limits and urobilin was absent. In the urine of patients with the black reaction of Buscaino positive in the urine, the author found also a positive reaction for indican, scatol and urorosine, and a positive reaction of Millon.

In twenty-five cases of dementia praecox, the results might be subdivided into two groups. In the first group, including recent cases, the observations are identical with those reported in cases of amentia, whereas, in the long-standing cases the author obtained negative results. In the old cases there was, however, a diminution of bilirubin, contrasting with the presence of urobilin.

The analogy of reaction of the group of amentia and the group of early cases of dementia praecox with symptoms of stupor and mental confusion upholds the identity of origin of these two conditions, whereas, the presence of aromaturia concomitant with aromatemia confirms the toxic intestinal origin advocated by Buscaino. Finally, with the rose bengal test it is possible to put in evidence an involvement of the liver which up to now was clinically absent.

FERRARO, New York.

TUMOR OF THE PETROUS BONE, OF MALPIGHIAN ORIGIN, INVOLVING THE DURA AND THE CRANIAL NERVES. J. ABADIE, M. LABUCHELLE and E. LAUBIE, Rev. d'oto-neuro-opht. **8**:758 (Dec.) 1930.

Malignant tumors of the middle ear frequently manifest themselves by appearing in the meatus, by invading the antrum or by labyrinthine disturbances or disturbances in the facial nerves, but cases in which the tumor penetrates the dura and involves the last cranial nerves are rare.

A woman, aged 42, entered the hospital with paralysis of the last five cranial nerves. There was a history of an otorrhea lasting four years, which was cured by operation but which had recurred a few months before admission and was accompanied by cutting pains in the left ear and mastoid. A mastoidectomy was done, and fleshy vegetations, filling the process and apparently arising in the

petrous bone, were found. Healing was prompt but the pains, discharge and deafness persisted and paralysis of the left facial and glossopharyngeal nerves appeared.

An examination revealed: total paralysis of the facial nerve, the pharynx, palate, larynx, sternocleidomastoid and trapezius muscles and absolute deafness, all on the left side; marked deviation of the tongue to the left. Ten weeks later, paralysis of the external oculomotor nerve and an abundant leakage of cerebrospinal fluid from the left ear appeared. Death occurred two days later.

Autopsy: After removal of the brain, the dura in front of the left posterior lacerated foramen was found raised and perforated by a fleshy mass, which spread out over the surface of the brain over an area as large as a franc piece. Beneath the dura the tumor was found emerging from the petrous bone through a large orifice at its extremity, which was extremely friable. The tumor filled the whole pyramid. The glossopharyngeal, spinal and hypoglossal nerves were embraced by the tumor, 0.5 cm. from their apparent origin, and the sixth nerve was flattened. Nothing of note was found in the other viscera.

Clinically and on macroscopic examination, a primary tumor of the petrous bone, invading the meninges, seemed to be the diagnosis, but histologically it was seen to be an invasion of the petrous bone and meninges by a "spinocellular" malpighian epithelioma. The progress was rapid from without inward and no masses were visible in the auditory canal. The origin must have been the pavement meatal epithelium or the cylindric epithelium of the middle ear. Epitheliomas of the middle ear occur, in general, in persons with old otorrheas or chronic suppurating fistulas. To be noted is the clinical analogy between the evolution of this tumor and that of cholesteatoma.

DENNIS, Colorado Springs, Colo.

ENDOCRINOLOGIC INVESTIGATIONS IN EPILEPTICS. H. I. SCHOU, Acta psychiat. et neurol. **5**:227, 1930.

Because of the numerous indications that the endocrine glands are disturbed in idiopathic epilepsy, the author instituted the following endocrinologic studies: (*a*) examination of the basal metabolism in 130 cases; (*b*) examination of the sugar metabolism in 50 cases; (*c*) examination for symptoms of tetany in 300 cases; (*d*) histologic examination of the endocrine glands in 25 cases.

(*a*) Of 130 cases, the basal metabolism was pathologic (above 110 or below 90 per cent) in 36 (27.7 per cent for both sexes, 27 per cent for men, 28.2 per cent for women). In 28 of the 36, it was below 90 per cent. Repeated examinations revealed a fluctuation of from 5 to 15 per cent, which seems not due to technical errors. Treatment of the patients with thyroidin raised the basal metabolism but had little effect on the fits.

(*b*) In examining the sugar metabolism, particular attention was paid to the threshold for sugar in the blood and in the urine. The patients with epilepsy showed a tendency to a low blood sugar during fasting and a divergence of the threshold in three directions: (1) no sugar in the urine in spite of a high rise in blood sugar; (2) sugar in the urine with only a small rise in blood sugar; (3) a difference in the threshold after the administration of epinephrine or dextrose so that with the same rise in blood sugar there was found either sugar in the urine after the administration of epinephrine and none after the administration of dextrose, or vice versa.

(*c*) Investigation of the presence of tetany in patients suffering from epilepsy (clinical examination, blood calcium estimations, hypoventilation and subsequent history of children who had tetany) revealed no connection between tetany and epilepsy.

(*d*) Histologic studies of the endocrine glands in patients with epilepsy show widely marked pathologic changes, particularly in the thyroid, parathyroids, pancreas, liver and kidneys.

The author concludes that there are endocrine changes associated with epilepsy, but he is unable to determine whether such changes are primary or secondary.

PEARSON, Philadelphia.

THE VESTIBULOCAPILLARY REFLEX. D. J. VASILIU, Rev. d'oto-neuro-opht. **8**: 753 (Dec.) 1930.

Based on the observations that the internal ear has a rich vascular network with terminal arteries, that excitation of the sympathetic system causes vasoconstriction, and paralysis, vasodilatation, that the peribulbar sympathetic plexus can provoke constriction and dilatation of the cerebral vessels, that the normal circulation of the ear is regulated by the periarterial cervical sympathetic plexus, that excitation of the labyrinth can cause distant vasomotor modifications, Vasiliu was able to demonstrate transient spasm followed by dilatation in the capillaries of the fingers during caloric stimulation of the ears.

According to Bartèles, caloric stimulation of the ears causes a reflex vasoconstriction and paralysis of the labyrinth, and the consequent nystagmus is produced by the opposite labyrinth. Barré, Draganesco and Lieou demonstrated vestibular phenomena following injections of procaine hydrochloride in the deep lateral cervical region. Medicinal substances have different effects on the labyrinth, depending on whether they are sympatheticotonic (epinephrine) or vagotonic (pilocarpine, physostigmine [eserine]). Stimulators of the sympathetic produce hyperexcitability and inhibitors produce hypo-excitability of the labyrinth. By studying the vestibulocapillary reflex, all these hypotheses can be confirmed or nullified.

The following procedure is suggested: 1. Test the subject to see if he is vagotonic or sympatheticotonic. 2. Test the vestibulocapillary reflex in both groups. 3. Administer drugs that will paralyze or stimulate the vegetative system and, with the capillaroscope, determine the modifications following the caloric test of the ears. 4. Test those patients who have had resection of the cervical or perivascular sympathetic. 5. Photograph the fugitive capillary spasm if possible. 6. Examine directly with the capillaroscope the meninges and brain in animals. 7. Look for the vestibulocapillary reflex in the fundus of the eye and at the sclerocorneal limbus.

By the accumulation of data from a large number of cases the author hopes to be able to give a more adequate explanation of the mechanism of the production of nystagmus and of labyrinthine pathology.

DENNIS, Colorado Springs, Colo.

NARCOLEPSY AND THE PITUITARY BODY. BEYERMANN, Arch. f. Psychiat. **91**:463, 1930.

At a meeting of the Southeastern German Association of Psychiatry and Neurology on March 1, 1930, the author presented a discussion of the relationship between disease of the pituitary body and the occurrence of narcolepsy. Several histories of cases were presented. In one, in a man, aged 20, spells of sleepiness and loss of tone had developed several years after an acute attack of encephalitis. With this condition he had shown a disturbance of secondary sexual characteristics and a marked increase in weight accompanied by low blood pressure and marked lymphocytosis. There was a decrease in the basal metabolic rate, and an x-ray picture showed a bridging of the gap between the clinoid processes. The second case was that of a girl, aged 15, of small stature and pronounced obesity, who had had an attack of encephalitis at the age of 8. She showed a definite retardation in physical development, typical of hypogenital adiposity. In this case, also, there was a low blood pressure, lymphocytosis and a decreased specific dynamic reaction. Roentgenograms showed a small sella with a very narrow entrance. The symptoms that brought her to the hospital were similar to those in the first case, that is, attacks of narcolepsy.

In these cases the therapeutic effect of anterior pituitary extract was tried. In the first case there was a prompt response so that two weeks after the beginning of the treatment there was a decrease in the number of narcoleptic attacks, and in four weeks they disappeared altogether. With the continuance of the

treatment, the attacks had not recurred six months after the original examination. There was also an arrest of the increase in weight. A similarly striking effect was obtained in the second case.

Two more patients with typical pictures of narcolepsy and signs of pituitary dysfunction had been treated more recently with the same substance and had shown good results. The author is of the opinion that one is justified in assuming a pituitary origin for narcolepsy and certainly in treating patients suffering from this disease with anterior pituitary extracts.

MALAMUD, Iowa City.

THE MEASUREMENT OF DEPRESSION-ELATION AND ITS RELATION TO A MEASURE OF EXTRAVERSION-INTROVERSION. H. H. JASPER, J. Abnorm. Psychol. **25**:307 (Oct.-Dec.) 1930.

Jasper refers to the work of Spearman, Conklin and Washburn, in psychologic fields, and to the work of Hoch, MacCurdy, Kretschmer, Rosanoff and White on manic-depressive psychosis in leading up to his discussion of a test for the measurement of depression-elation which he designates as the DE test. In this DE test it is attempted to combine the three ambivalent characteristics of emotional temperament, which he calls depression-elation, optimism-pessimism and enthusiasm-apathy.

He then presents the test questions, forty in number, and gives the extent of the validity of the test. His conclusions are: 1. A measure of depression-elation has been developed which is practicable for use with large groups of "normal" persons of college age. 2. The DE test has shown sufficient reliability to indicate that it is measuring some functional unity running through the different reactions measured. This reliability should be checked with the results of many different types of measures of this function. 3. The test has shown sufficient validity to indicate that one is justified in calling this trait depression-elation. 4. A very slight positive relationship has been shown between elation and intelligence and between elation and high academic grades. (Elation and intelligence must be interpreted in terms of the measures employed.)

The author states further that a significant positive relationship has been shown between a predominance of introverted interests (as measured by the Conklin E-I Interest test) and the predominance of depression in characteristic affective tone and attitude (as measured by the DE test herein described). He is aware of the difficulties inherent in any type of method of measuring emotional reactions by questionnaires. Some of the difficulties have been removed by the use of an indirect type of question in the DE test. One cannot assume that the answers to the questions themselves are absolutely valid for situations other than the test situation.

WILLEY, Harrisburg.

DEVELOPMENTAL DISTURBANCES OF THE PURKINJE NEURONS. K. VON SANTHA, Arch. f. Psychiat. **91**:373, 1930.

The author reports the results of studies in sixty-one cases. In these cases, eleven patients were schizophrenic; two had paraphrenia; three, senile dementia; two, Alzheimer's disease; one, cerebral arteriosclerosis; one, tuberous sclerosis; four, feeblemindedness; five, dementia paralytica; one, paralysis agitans, juvenile; two, multiple sclerosis; two, epilepsy; one, rabies; one, tuberculous meningitis; one, pituitary tumor; two, polyneuritis; two, alcoholism; four, uremia; three, yellow atrophy of the liver; one, tuberculosis; two, glioma of the brain; two, angioma of the cerebellum; one, a normal cerebellum; three, Tay-Sachs' disease. One case showed the brain of a talented musician. Studies were made of the cerebellum, with special emphasis on the Purkinje neurons. In these neurons special attention was given to the position, shape and structure of the cell bodies, the presence of more than one nucleus, disturbances of the dendrites and disturbances of the axons. The methods used were primarily those of Cajal and Bielschowsky with frozen sections and paraffin blocks. In some cases the hydroquinone-silver stains were also used.

The results are summarized as follows: Disturbances in the position and shape of the Purkinje cells, as well as the occurrence of two or more nuclei, must be considered as a primary dysgenesis and not as being caused by any pathologic process. This must also be regarded as true in the case of abnormalities in the dendrites. In the case of the axons there may be two types of changes. The axons that spring from the lateral part of the cell body and branch out into the molecular layer should be looked on as dysgenetic, whereas abnormal axons coming from other parts of the body may be looked on as secondary occurrences.

MALAMUD, Iowa City.

BIOLOGICAL AND SEROLOGICAL METHODS OF DIAGNOSIS IN EPILEPSY. EUGENE DE THURZO, J. Neurol. & Psychopath. **11**:36 (July) 1930.

The author gives a summarized account of many of the chemical and biologic methods that have been described for the diagnosis and the treatment of epilepsy. A new simple method for colloidal reactions, utilizing china ink, is described. Three small test tubes are used, into each of which is placed 0.1 cc. of spinal fluid. Immediately, 0.5 per cent oxalic acid is added, 1 drop into the first, 2 drops into the second and 3 drops into the third test tube. Finally, 1 cc. of a 1 per cent solution of china ink is added to each of the three tubes (Günther Wagner's original "Perltusch"). The result of the reaction can be read in from fifteen to twenty minutes, or after centrifugating for one and one-half minutes.

The reading of the result is somewhat different from that of other colloidal reactions. The end-point varies from no reaction, when the colloid is protected against a precipitating effect, to complete precipitation, and an intermediate stage between colloid protection and precipitation. A normal spinal fluid shows no reaction in the first and second tubes with complete precipitation in the third tube. The author found it advisable to express the change numerically. By utilizing the numerical figures in each reaction, an index for colloid protection can be determined. This index in normal spinal fluid is 0, whereas, in 80 per cent of cases of epilepsy, the index for colloid protection was found to be 2. This, according to de Thurzo, demonstrates that the china ink test is more sensitive and more valuable in the diagnosis of epilepsy than any other known serologic method. A tabulation is included from which a comparison of the various tests on the spinal fluid used in diagnosis can readily be obtained.

The author does not consider in his bibliography the excellent American and English contributions that have been made on this symptom-complex.

BECK, Buffalo.

THE PROBLEM OF CONGENITAL MENTAL DEFECTS: ENCEPHALOGRAPHIC OBSERVATIONS IN CONGENITAL AND EARLY ACQUIRED FEEBLEMINDEDNESS. H. WINKLER, Arch. f. Psychiat. **91**:495, 1930.

Seventy-eight feebleminded patients were subjected to encephalography. These patients included sixteen morons, thirty-eight imbeciles and twenty-four idiots. The results of the investigation are given in an extensive chart in which comparisons are made between the encephalographic observations and clinical factors such as neurologic signs, heredity, degree of feeblemindedness, etc.

In thirty-one of the cases, definite pathologic changes were found in the ventricular system. In thirteen cases there was a slight dilatation of the ventricles but such as could not be definitely considered pathologic. In sixteen cases, filling defects in different parts of the ventricular system or cerebral surface were found; here again, however, they were such as could not be considered definitely pathologic. The results in the other cases showed no deviations from the normal.

In comparing these observations with the degree of feeblemindedness, no definite correlation was discovered. It seemed, however, that the idiots showed, relatively, a more frequent pathologic condition than the morons or the imbeciles. Similarly, there did not seem to exist any definite correlation between positive neurologic

signs and positive encephalographies. In only thirteen of the cases that showed pathologic encephalograms were neurologic disturbances found to be present, whereas of the seventy-eight cases altogether there were twenty-seven that showed definite neurologic disturbances. In all cases in which there was a history of injury at birth (there were sixteen of these) the encephalograms showed pathologic changes.

MALAMUD, Iowa City.

PSYCHOSIS ASSOCIATED WITH MYXOEDEMA. L. H. ZIEGLER, J. Neurol. & Psychopath. **11**:20 (July) 1930.

Not every myxedematous patient has depression, elation or an overactivity reaction, nor is myxedema an associated state in all patients who have these psychotic reactions. However, in the cases described, thyroid deficiency appears to have had the effect of bringing into relief latent hereditary disposition and constitutional tendencies. Three new case reports of psychoses associated with myxedematous states are given.

Case 1 is that of a married woman, aged 49, who was seen about one year following the menopause. She was in the depths of a physiologic sluggishness to which she had descended while in a state of marked myxedema. This state became apparent after treatment with roentgen rays to the thyroid gland. She had a psychosis in which jealousy and fear of being poisoned were the outstanding symptoms. A brother was suspicious and was afraid of being poisoned. Recovery was concomitant with the regular administration of desiccated thyroid gland. She has remained well for about a year.

Case 2 is that of a woman, aged 39, whose mother had had several severe depressed reactions. The patient experienced several short depressed periods concurrent with the development of an exophthalmic goiter. Subsequently, a myxedematous condition occurred, with a severe retarded depression. This was considerably relieved by the administration of desiccated thyroid gland.

Case 3 is that of a sociable, hypomanic woman, aged 58. Myxedema developed after thyroidectomy. During recovery, while she was taking desiccated thyroid gland, she became mildly manic; she recovered her normal personality when the basal metabolic rate became normal.

BECK, Buffalo.

A REPORT ON EXPERIMENTS ON RABBITS WITH A VIEW TO DETERMINING THE TIME TAKEN BY THE REACTION OF THE EYE ON MECHANICAL OR GALVANIC IRRITATION OF THE LABYRINTH OF THE EAR. G. DOHLMAN and G. ENGVALL, Acta psychiat. et neurol. **5**:213, 1930.

The passage of an electric current through the head of a human being produces giddiness and movements of the eyeballs. Several hypotheses have been advanced in explanation of these phenomena. Hitzig thought that they were due to irritation of the brain. Breuer and Ewald considered that they were due to irritation of the nerve epithelium in the labyrinth or to irritation of the vestibular nerve itself. Bruning believed that the current set up movements in the endolymph, i. e., that its mechanism did not differ from that of rotation and caloric irritation. If the latter theory were true the elapsed time from the application of the stimuli to the movements of the eyeball would be the same whether the current or the other types of stimulators were used. In order to study this point, the authors experimented on rabbits, using as a recording apparatus the optic instrument devised by Dohlman.

They found that with the mechanical method, in which the endolymph was set in motion, the rabbit's eye did not respond to successive stimuli at a rate higher than 70 per second. With the electric method it responded to rapidly succeeding galvanic shocks at as high a frequency as 150 per second. They conclude that the two methods of stimulation have different points of action — the mechanical on the nerve epithelium, the galvanic probably on the vestibular nerve and ganglion.

PEARSON, Philadelphia.

PATHOLOGY AND SYMPTOMATOLOGY OF METASTASIS OF CARCINOMA TO THE CENTRAL NERVOUS SYSTEM. WALTER PUTSCHAR, Ztschr. f. d. ges. Neurol. u. Psychiat. **126**:129, 1930.

Among 12,730 necropsies Krasting found 36.81 per cent of metastases to the brain, among which carcinoma was to sarcoma as 3:1. Sarcoma metastasizes to the nervous system three times as frequently as carcinoma, though in absolute numbers it is less common than the latter. The metastatic tumors of the nervous system may be divided into four groups according to localization: (1) metastases to the brain and cord, (2) metastases in the pia and arachnoid, (3) metastases in the dura and (4) metastases in the intradural portions of the cerebral and spinal nerves.

Clinically, there is no unity to the changes found in metastatic carcinoma in the nervous system. Clinical signs may be completely lacking and carcinoma may be found at necropsy as a purely accidental observation. On the other hand, there are cases that show exquisite clinical symptoms and no changes histologically. The onset may be sudden, like that of apoplexy. The clinical picture of meningeal carcinoma is characteristic, and when an increase of albumin and tumor cells is found on lumbar puncture, the diagnosis is made.

Putschar reports a few cases of metastatic carcinoma, one of which showed a rather rare localization—in the nerves of the cauda equina. These were infiltrated with tumor cells. This localization has been reported in only a few cases.

ALPERS, Philadelphia.

A CLINICAL AND PATHOLOGICAL STUDY OF THREE CASES OF EPIDEMIC ENCEPHALITIS. ARTHUR POOL, J. Neurol. & Psychopath. **11**:45 (July) 1930.

Three case reports of parkinsonism following epidemic encephalitis with complete pathologic observations, are presented. As in cases reported by other authors, the more distinctive lesions were found in the nucleus ruber and the substantia nigra, with secondary descending degeneration of the fibers of the rubrospinal tract. According to Pool, parkinsonian disease is a release phenomenon. The rubrospinal tract terminates, in the main, as an arborization about the intermediolateral cell column. As this cell column furnishes the preganglionic sympathetic fibers, and as sympathetic overaction is explanatory of the main features of parkinsonism, the "release" in these cases is the sympathetic element—a decontrol.

The presence of hyperglycorrhachia and glycosuria in some of the patients with epidemic encephalitis is considered. The author believes that a disturbed sugar metabolism occurs only when there is degeneration in the rubrospinal system. Not every case in which there is a change in this tract shows such a disturbance, and he therefore concludes that specific fibers that govern the sympathetic nerve cells connected with the suprarenal gland and the liver must be affected.

The symptoms of palilalia and sialorrhea are probably the result of phenomena due to the products of cell destruction. The type of inflammatory process seen in the cases suggests that the disease is a manifestation of a chronic progressive encephalitis rather than the sequel of an acute infection.

BECK, Buffalo.

RATIONALIZING THE SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM. W. K. LIVINGSTON, J. A. M. A. **96**:852 (March 14) 1931.

Evidence is accumulating to indicate that the visceral nervous system regulates or has some relation to a large number of physiologic mechanisms. The many clinical syndromes that are now approached by way of sympathetic ganglionectomy may be grouped into three categories, all of which have as a common characteristic hypertonus of smooth muscle: (1) syndromes in which visceral pain is the major symptom; (2) those that may be ascribed to overactivity of the sphincter muscle, and (3) those in which the most striking characteristic is a

functional limitation of the blood supply. As examples of the latter class, arthritis and endarteritis obliterans are discussed with respect to the rise in the temperature of the skin of the affected part following sympathectomy. In endarteritis a good surgical prognosis depends on the preponderance of functional spasm over organic changes; two methods for the determination of this preponderance are described. The preferred test involves the determination of the "vasomotor index," obtained by dividing the rise in the temperature of the skin by the rise in the temperature of the mouth after the induction of artificial fever. Selective injection of the ganglion with procaine hydrochloride will simulate the effect to be expected from surgical extirpation and affords a method for differentiating somatic from visceral pain; it should prove of value in enlarging the field for the application of this type of surgical intervention.

JENKINS, Indianapolis.

NEUROLOGIC AND PSYCHIC PHENOMENA FOLLOWING POISONING WITH CARBON BISULPHIDE. K. BONHOEFFER, Monatschr. f. Psychiat. u. Neurol. **75**:195 (April) 1930.

The clinical pictures presented by fourteen patients suffering from poisoning with carbon bisulphide are summarized in this article. The most frequent and characteristic symptoms were headache, dizziness and weakness, accompanied by irritability and sleeplessness. Vague complaints referable to the stomach were common. In nine cases symptoms of a neuritic nature were observed. They consisted mainly in complaints of paresthesias, numbness, pains and muscular cramps. Increased sensitiveness to pressure over the nerve trunks and muscles occurred frequently, but gross neurologic signs were lacking. Three patients showed retrobulbar neuritis. Hearing was impaired in two cases. This was considered to be due to toxic injury of the auditory nerves. An acute psychosis characterized by impaired orientation, defective memory, rapid swings of mood, and auditory and visual hallucinations developed in one patient. Complete recovery took place within five days. Thirty-six per cent of the patients exhibited hysterical phenomena which were apparently related to the question of compensation. The prognosis in regard to the neuritic symptoms is favorable. Permanent psychic defects were not observed.

ROTHSCHILD, Foxborough, Mass.

REFLEX TRANSMISSION OF STIMULI FROM ONE EYE TO THE OTHER. A. FEIGENBAUM, Arch. Ophth. **5**:261 (Feb.) 1931.

The "dark-light test," which the author presents in detail in this paper, is an important functional test in glaucoma. The article is abstracted here in view of responses in an eye after an optical neurectomy. The test consists of tonometric measurements taken before and after a stay in the dark, and again during the illumination of one eye while the other eye is entirely protected from light. The author cites repeated instances of transmission of stimuli from one eye to the other as presented by various authors and various investigators. For this discussion, cases were studied showing the reflex vasomotor process that occurs as a result of the "dark-light test" after neurectomy. Repeated tests illustrated the interruption of conduction of stimuli from one eye to the other.

The paper is valuable because it discusses vasomotor reflexes. The author gives his conclusions in a good summary. The neurectomized eye reacts in a typical way, although the sensitive connections with the centers are cut. Thus one may assume a so-called axon reflex, i. e., a short reflex that does not pass through the center (intra-ocular vasomotor reflex of the uveal vessels). The influence of the second eye probably likewise consists in a primitive reflex of this kind, i. e., an interocular vasomotor reflex transmission of stimuli.

SPAETH, Philadelphia.

ARE NEUROLOGY AND PSYCHIATRY SEPARATE MEDICAL ENTITIES? V. C. BRANHAM and R. B. MCGRAW, J. Nerv. & Ment. Dis. **73**:144 (Feb.) 1931.

The results of questionnaires sent to 222 physicians of New York City specializing in psychiatry, neurology and neuropsychiatry are published with quotations from 29 outstanding men. The questionnaire was devised by a subcommittee of directors of New York clinics. One hundred and twelve answers were returned. The questionnaire not only covered opinions regarding neurology, psychiatry and neuropsychiatry as separate entities, but endeavored also to define delimitation of material in the respective fields. A preponderance of opinion favored delimitation of neurologic material to disorders arising from alterations in the structure of the nervous system and delimitation of psychiatric material to mental disorders mainly psychotic in nature. The disposal of psychoneurotic material showed a considerable confusion as to proper methods and this confusion was also found relevant to cases with organic nervous changes in which psychoses rather than sensorimotor disorders were the chief symptoms presented. Little appreciation of the social adaptation and personality integration involved in these problems was shown by the practitioners. The term neuropsychiatry, considered logical by 55 and illogical by 85, was regarded as useful inasmuch as the average neurologist or psychiatrist has to treat both neurologic and psychiatric conditions in order to make a living.

HART, Greenwich, Conn.

THE NATURE OF GRAVES' DISEASE. ELI MOSCHOWITZ, Arch. Int. Med. **46**:610 (Oct.) 1930.

Taking issue with the conventional concept of Graves' disease as a well defined clinical unit, Moschowitz points out that hyperthyroidism is the expression of a temperament rather than a specific disease. He believes that it is the reflection of a constitution which is often familial, and which frequently has as its anatomic basis the thymicolymphatic diathesis. A psychic stimulus, such as a sudden and frightful experience, seems capable of precipitating an attack of Graves' disease when it is applied to this sort of organic substratum. The excessive thyroid function represents at the most a manifestation of the disease; it is not its origin. In support of this conception of a secondary association between Graves' syndrome and the thyroid gland, Moschowitz calls attention to the infrequency of the syndrome in goiterous districts, to the many cases without thyroid hyperplasia and to the want of parallel between extent of the hyperplasia, on the one hand, and the clinical phenomena on the other. With a more rational understanding of the nature of Graves' disease, a more rational therapy can be introduced; no form of treatment is wise which forgets that it is a temperament that has to be managed and not a thyroid gland.

DAVIDSON, Newark, N. J.

THE MORPHOLOGIC CORRELATE OF MUSICAL TALENT. J. SOMOGYI, Monatschr. f. Psychiat. u. Neurol. **75**:138 (March) 1930.

In an attempt to localize the cerebral centers particularly concerned with ability in music, the author studied the brains of two extremely talented musicians. The outstanding feature in both cases was that the middle third of the superior temporal convolution and the inferior portion of the parietal lobe, more especially the supramarginal gyrus, were unusually well developed. There was no apparent difference between the right and left cerebral hemispheres. No abnormalities were observed in the myelin structures or cortical laminations. In one case, however, the nerve cells of the right and left superior temporal convolutions were larger than normal. The author believes that the morphologic basis of musical talent is to be found primarily in an enlargement of the surface area of the regions mentioned. Hereditary factors are probably responsible for this hypertrophy. The author's observations, taken in conjunction with those of other investigators, lead him to conclude that the sensory center for music is located in the middle third

of the left superior temporal convolution. However, the possibility that the same area of the right side of the brain participates in this center cannot be definitely excluded.

ROTHSCHILD, Foxborough, Mass.

STUDIES IN THE PATHOGENESIS OF HEPATOLENTICULAR DEGENERATION. MAX SCHMIDT, Acta psychiat. et neurol. **5**:163, 1930.

The author reports briefly the anatomopathologic changes in four cases of hepatolenticular degeneration. In two acute cases, the liver showed a process of degeneration, apparently corresponding in age to the neuroglial degenerations. The two other cases were more chronic. In one case of at least five and one-half years' duration, there were degenerative changes (proliferation of the neuroglia, destruction of the ganglion cells and less marked proliferation of the microglia) limited to the putamen and caudate nuclei. The liver showed cirrhosis with large nodules, but with little increase in connective tissue. Microscopically, there was necrosis of the liver cells. In the other case of fourteen years' duration, the neostriatum showed proliferation and increase in size of the neuroglia, disappearance of the ganglion cells and on the right a status spongiosus. There was also degeneration of the anterior nucleus of the thalamus and of the segment of Sommer. There was marked loss of ganglion cells in the olives, less marked in the dentate nuclei. The liver showed cirrhosis (increase of connective tissue). The author believes that these changes point to a toxic etiology, particularly as they select the most vulnerable parts of the central nervous system.

PEARSON, Philadelphia.

THE COURSE OF THE NERVE FIBERS TRANSMITTING SENSATION OF TASTE. DEAN LEWIS and WALTER E. DANDY, Arch. Surg. **21**:249 (Aug.) 1930.

After listing the confusing theories of the conduction of taste, Lewis and Dandy suggest that this sensation, as far as the anterior two thirds of the tongue is concerned, is carried along the nervus intermedius of Wrisberg (the afferent division of the facial nerve). Stimuli mediate the taste buds and send impulses through the chorda tympani by way of the facial nerve and geniculate ganglion, and then along the nervus intermedius into the tractus solitarius in the pons. The possibility of conduction along the fifth nerve is eliminated by the observation that section of this trunk is not followed by permanent ageusia, whereas intracranial division of the sensory part of the seventh nerve results in loss of taste from the anterior two thirds of the tongue. The accepted theory that the ninth nerve carries the sensation of taste from the back of the tongue is confirmed by the clinical and experimental work of Lewis and Dandy.

DAVIDSON, Newark, N. J.

THE BLOOD PRESSURE DURING HYPERVENTILATION AND DURING THE EPILEPTIC FIT. V. HENDRIKSEN, Acta psychiat. et neurol. **5**:323, 1930.

The author studied the blood pressure during hyperventilation in thirty-six persons, thirty-two of whom suffered from epilepsy. In thirteen of the latter he continued the study during the fit produced by the hyperventilation. He studied also two cases of status epilepticus. Hyperventilation produces a fall in systolic blood pressure, which rises to normal after the hyperventilation ceases. The diastolic pressure shows a similar reaction, but to a much smaller degree. The pulse is increased in rate at first, then gradually diminishes until at the end of the experiment it has reached normal. The rhythm is not altered, but the force decreases irregularly. The epileptic seizure, whether natural or induced, is always accompanied by a sudden rise in systolic blood pressure, usually beginning just before the fit appears, although it may commence some minutes earlier. The end of the attack is accompanied by an equally sudden fall in the blood pressure to the same level as before the attack. The diastolic blood pressure and the pulse are only slightly affected.

PEARSON, Philadelphia.

TREATMENT OF TRIGEMINAL NEURALGIA WITH TRICHLORETHYLENE. MARK ALBERT GLASER, J. A. M. A. **96**:916 (March 21) 1931.

Following the report by Plessner of cases of industrial exposure to trichlorethylene in Germany in 1915, the results of which included anesthesia in the trigeminal area, this drug was suggested for use in the treatment for trigeminal neuralgia. The literature now includes 177 patients so treated, with complete relief from pain in 15 per cent and partial relief in 51 per cent, though the percentages are changed to 25 and 44, respectively, if one includes the first series reported by Plessner in 1916, in which a high percentage of cures was recorded. In the author's series, 13.3 per cent of patients were partially relieved. The drug is administered by inhalation, it is not toxic, and in therapeutic use it has not produced anesthesia even when relieving pain. It therefore seems unlikely that trichlorethylene is the original substance responsible for the symptoms in industrial workers. Because of the absence of anesthesia, trichlorethylene is ideal in the treatment for trigeminal neuralgia in cases in which the drug is effective.

JENKINS, Indianapolis.

THE HEART RATE IN PROGRESSIVE MUSCULAR DYSTROPHY. E. P. BOAS and H. LOWENBURG, Arch. Int. Med. **47**:376 (March) 1931.

In a study of the heart rates of seven patients with progressive muscular dystrophy, Boas and Lowenburg found a constant tachycardia. Previous studies with the cardiotachometer had demonstrated that the normal average heart rate is 77 and that in persons with muscular dystrophy it is 90. Since tachycardia was observed in these subjects even during sleep, it cannot be accounted for by neurogenic factors. The authors believe that the loss of the pumping effect of the striated muscles because of their disability is, in part at least, responsible for the disturbance of the heart rate. They also accept the observations of pathologists who report myocardial fibrosis and fatty infiltration in many cases of this kind. The cardiotachometer was used also on patients who were helpless because of other diseases, such as arthritis, and in these cases a rapid heart rate was likewise demonstrated. This tends to confirm the author's belief that disuse of the peripheral musculature can so modify the distribution of blood in the vascular tree as to disturb the heart rate.

DAVIDSON, Newark, N. J.

NOTE ON SEA-SICKNESS. MARTIN FLACK, Brit. M. J. **1**:176 (Jan. 31) 1931.

One hundred and sixty-two cases of sea-sickness were studied on board ship to ascertain the relationship between the maintenance of ocular poise, pulse rate and blood pressure. The author's conclusions are: 1. Sea-sickness is predominantly of vestibular origin and is caused by uneven movement. 2. In certain cases in which the labyrinths are unduly sensitive, vomiting may occur early, due to reflex stimulation of the vagus motor fibers to the stomach. Such cases are of the type that also favors air-sickness. 3. In cases of sea-sickness in which the labyrinth cannot be deemed unduly sensitive, its stimulation early induces or aggravates a degree of imbalance of the ocular muscles, which, combined with the continued stimulation of the vestibular apparatus, serves to provoke further symptoms. 4. Generally speaking, subjects in whom imbalance of the muscles of the eye is not induced or aggravated do not suffer from sea-sickness, although a slow pulse rate and a lowered blood pressure may cause a feeling of "limpness."

FERGUSON, Niagara Falls, N.Y.

ENCEPHALOGRAPHY IN CASES WITH FIXED LESIONS OF THE BRAIN. BRONSON CROTHERS, EDWARD C. VOGT and R. CANNON ELEY, Am. J. Dis. Child. **40**:227 (Aug.) 1930.

Deploring the vagueness of such diagnoses as "feeblemindedness," "epilepsy" and "cerebral diplegia," and disappointed by the futility of the ordinary procedures

of hospital "observation," Crothers and his colleagues suggest the wider use of encephalography as a diagnostic measure. In cases in which doubt exists as to the anatomic diagnosis, a definite understanding of the condition is difficult without an encephalogram, whereas in no case are matters made worse by this procedure. The authors state categorically that 50 per cent of their encephalograms have revealed evidence of anatomic abnormality of the ventricular system, an incidence of positive results which, they believe, makes the performance advisable in selected cases. In their work on children they found that induction of drowsiness by small doses of morphia and local anesthesia by the injection of procaine hydrochloride constituted the least alarming and most convenient method of assuring docility on the part of the patient.

DAVIDSON, Newark, N. J.

A STUDY OF THE WOODWORTH PSYCHONEUROTIC INVENTORY WITH SUGGESTED REVISION. M. J. PAPURT, J. Abnorm. Psychol. **25**:335 (Oct.-Dec.) 1930.

Psychiatrists who have used the Woodworth Psychoneurotic Inventory in attempting to measure emotional stability will be interested in the work that Papurt describes with this questionnaire and in his suggestions for its improvement. He believes that in the original test the terminology was too complex for the average subject; that the list of questions was too lengthy; that there was considerable duplication of contents; that many questions were introduced which had no bearing on a diagnosis of emotional instability, and that some of the original test was too arbitrarily masculine.

Papurt suggests a revision of this test. In this revision he omits about one third of the material contained in the original test. He states that it has been used with excellent results in various clinics, and that standardization and testing of this revision are now being carried on. The revised test would appear to be considerably simpler than the original and to offer the added advantage of saving time and of not confusing or tiring the subject to the extent that the original did.

WILLEY, Harrisburg.

PAIN. D. C. SUTTON and H. C. LUETH, Arch. Int. Med. **45**:827 (June) 1930.

Sutton and Lueth investigated the mechanism of cardiac pain in dogs by ligating the coronary arteries and by inserting instruments into the great vessels. Narrowing the lumen of the descending ramus of the left coronary artery produced pain, which varied with the amount of occlusion and stopped when the vessel was allowed to return to its normal size. This could not be due to catching myocardium or pericardium in the ligature, as manipulation of these tissues caused no pain. Section of the vagi did not modify the pain, indicating that the pathway must have been through the sympathetic nerves. The nerve fibers responsible were those in the adventitia of the artery. Acute mechanical distention of the great vessels failed to produce pain. The authors believe that the pain of angina pectoris is due to interference with the nutrition of the muscles of the heart, and that this may be brought about through spasm or occlusion from other causes.

DAVIDSON, Newark, N. J.

TREATMENT OF PERNICIOUS ANAEMIA WITH HOG'S STOMACH. JOHN F. WILKINSON, Brit. M. J. **1**:85 (Jan. 17) 1931.

The author presents his observations in 108 consecutive cases of uncomplicated pernicious anemia treated with hog's stomach. Some of the cases have been followed for eighteen months; 92.7 per cent of the patients are perfectly well and free from symptoms; 6 per cent are well, but still suffer from some degree of nervous impairment. These figures are remarkable when compared with the results obtained with liver therapy. The improvement is always more rapid.

Of particular interest to neurologists is the observation that in cases showing early posterolateral involvement of the spinal cord, several have shown remarkable improvement, and paresthesias of the hands and feet (without alteration of the reflexes) have been almost completely cured in nearly every case. According to the author, these have always been the symptoms most resistant to treatment.

FERGUSON, Niagara Falls, N.Y.

COLOR CHANGES IN EXCISED AND INTACT REPTILIAN SKIN. CHARLES E. HADLEY, J. Exper. Zool. **58**:321 (Jan. 5) 1931.

The melanophores of isolated patches of the skin of *Anolis iodurus, Anolis carolinensis* and *Anolis watsoni* react to changes in illumination. The melanophores of *Anolis iodurus* expand maximally following intraperitoneal injection of a solution of pituitary extract, and remain expanded when the animal is exposed to a white background, to which the animal normally responds by rapid contraction of the melanophores. Intraperitoneal injection of a solution of epinephrine produces contraction of the melanophores, with subsequent failure of reaction to the background. Melanophores of excised patches of skin from *Anolis iodurus* expand rapidly when the skin is exposed to solutions of either pituitary extract or epinephrine. The results indicate that direct action of epinephrine on melanophores in an intact animal is unlikely, but that direct action of pituitary extract is a possibility.

WYMAN, Boston.

RESEARCHES INTO THE FORMS OF INTELLIGENCE. RICHARD MEILI, Arch. de psychol. **22**:201 (July) 1930.

The author discusses two theories regarding intelligence: (1) that it is a combination of many separate components; (2) that it is a single phenomenon which expresses itself in various ways. In order to investigate this question, he devised a series of tests (which he describes fully) and rated on a point scale the results of their application to a large number of children. He considers that his tests show that intelligence exhibits itself predominantly in one of the following ways: analytically, inventively or through abstract or concrete visualization. However, although one characteristic is predominant, the others are found, also. From his results he constructs intelligence profiles which indicate that this is true. His results then indicate that there are different factors in intelligence but that these factors are only different forms of expression for the intelligence. The latter is an entity, the expression of the person as a whole.

PEARSON, Philadelphia.

NEURASTHENIA AS A MANIFESTATION OF EMOTIONAL DISTURBANCES. HERBERT J. DARMSTADTER, Am. J. M. Sc. **181**:323 (March) 1931.

Darmstadter believes that the commoner cases of the neuroses can be understood biologically without calling in the aid of the psychoanalytic method. The neurasthenic response is regarded as an emotional reaction to depressing wishes and thoughts that have been suppressed because of their painful nature. Emotion results when physical changes occurring in the person are recognized. Symptoms simulating organic diseases may be produced by protracted emotions, particularly by fear. To understand neurasthenia, the word fear is supplanted by the term anxiety which adds an element of uncertainty; fear is static and anxiety fluctuates. The exhaustion in neurasthenia is accounted for by a prolonged conflict which gives rise to a disinclination for ordinary activities. In summary, an attempt is made to explain the more characteristic symptoms on a "purely psychogenic basis and through the agency of mental mechanisms that are relatively simple."

MICHAELS, Detroit.

CLINICAL PSYCHIATRIC SERVICE ON A PART TIME BASIS: ITS ADVANTAGES AND DISADVANTAGES. E. S. RADEMACHER, Ment. Hyg. **15**:81 (Jan.) 1931.

The traveling part time psychiatrist is confronted with many problems. He is compelled to confine his service to diagnosis, and to rely on the social worker for treatment. He has no time for lengthy conferences or research. Often he complicates issues until he gets acquainted with the methods and leanings of his co-workers, or until he orients himself in the facilities of the community. To reciprocate for these shortcomings he has, however, work free from monotony, diversified and vast material and an opportunity for objective evaluation of the agencies in the several communities. But perhaps the most impressive service rendered by a part time psychiatrist is the fostering of the work of mental hygiene in communities that ordinarily could not afford it.

DAVIDSON, Newark, N. J.

THE STATUS OF TESTS OF HEARING WITH A REPORT OF A SPEECH INTERPRETATION TEST. DOUGLAS MACFARLAN, Arch. Otolaryng. **13**:47 (Jan.) 1931.

Notation of the percentage of loss of hearing is difficult because there is no objective standard. Efforts have been made to develop a definite unit of hearing. Forks have been standardized by physicists, and speech tests have been proposed with phonographic records. Children may not respond to tests for single tones, but will respond to rhythm. "A patient may hear speech well and tones poorly, or vice versa." A long list of monosyllabic words has been compiled by the author. Some of the words have been used in phonographic records, in which the intensity may be changed. The child's answers are noted on the examiner's key. The percentage of loss of hearing is discussed.

HUNTER, Philadelphia.

THE TREATMENT OF NEUROSYPHILIS. R. H. FOSTER, Am. J. Syph. **14**:89 (Jan.) 1930.

On finding the malarial treatment for dementia paralytica unsatisfactory, Foster made use of tryparsamide. He gave the drug in doses of 3 Gm. intravenously, once a week for two or three months, and followed this by a course of treatments with bichloride of mercury. He warns against the danger of arsenical optic atrophy and insists that an ophthalmoscopy must precede each course of treatment with tryparsamide. The results of this treatment among colored patients were not impressive, but most of such patients were in a very poor condition at the start. Of fourteen white patients, nine were mentally improved and twelve physically improved. Although Foster recognizes that these results are hardly good enough to provoke much enthusiasm, he believes that the same patients who had improved under tryparsamide therapy would have died if they had not been treated.

DAVIDSON, Newark, N. J.

A METHOD OF EXCITING INCIPIENT MOVEMENT IN WEAKENED AND PARALYZED MUSCLES. ARTHUR E. PORRITT and O. F. GUTHRIE SMITH, Brit. M. J. **1**:54 (Jan. 10) 1931.

The authors describe a method of exercise for weakened muscles which is claimed to be particularly suitable in cases of fracture, poliomyelitis and spastic paralysis. The weight of the limb and the pull of antagonistic muscles are eliminated by suspending the affected extremity in a hammock or sling attached to an overhead pully. Swinging movements of the limb are instituted either by an operator or by the patient himself. The authors find that mental tranquillity is produced, and that the fear attendant on the usual procedures of massage or manipulation is obviated. Thus the treatment is doubly effective.

FERGUSON, Niagara Falls, N.Y.

PROLONGED TREATMENT OF EXOPHTHALMIC GOITER BY IODINE ALONE. W. O. THOMPSON, P. K. THOMPSON, A. G. BRAILEY and A. C. COHEN, Arch. Int. Med. **45**:481 (April) 1930.

After administering iodine in the form of a compound solution, representing 6 mg. to the drop, to sufferers from exophthalmic goiter and sustaining the drug for a year or more, Thompson and his colleagues conclude that in mild cases of exophthalmic goiter this form of therapy is of distinct value. In the more severe cases, however, improvement was temporary and sometimes not noted. Considering the unselected series of mixed cases representing all grades of severity, he reports 64 per cent of them improved definitely; 22 per cent as showing fair progress, and 14 per cent remaining unimproved. Thompson concludes, therefore, that iodine alone is a valuable weapon in the treatment for mild cases of exophthalmic goiter.

HIGH PHOSPHORUS CONCENTRATIONS IN INFANTILE TETANY. E. MARPLES and E. CRUMP, Am. J. Dis. Child. **39**:536 (March) 1930.

Most of the blood chemistry studies in infantile tetany have concerned themselves with the low calcium content of the serum. Dr. Crump and Miss Marples call attention to the fact that an interesting change occurs also in the phosphorus composition of the blood. They found that one fourth of their cases showed an inorganic phosphorus content exceeding 7 mg. per hundred cubic centimeters of serum. In some cases the phosphorus index was as high as 12. There seems to be no way of distinguishing the low phosphorus group from the other 75 per cent of the cases. The authors suggest that the existence of a low phosphorus blood serum is concerned with modifications in the buffer system regulating the calcium ion concentrations.

HIGH ELECTRICAL RESISTANCE OF THE SKIN OF NEW-BORN INFANTS AND ITS SIGNIFICANCE. CURT P. RICHTER, Am. J. Dis. Child. **40**:18 (July) 1930.

Further evidence that resistance of the skin decreases during states of anxiety and increases during sleep and relaxation is offered by Richter. He shows that infants, who sleep most of the time, have an average electrical resistance of the palmar skin in excess of 4,000,000 ohms, while adults average less than 200,000 ohms. Higher readings were obtained from the more quiet infants. The presumption is that resistance of the skin to electricity with more intense sweat-gland activity and the high readings of the resistance of the skin are associated with decreased sympathetic tone, if not with positive vagotonia.

INCIDENCE OF SYPHILIS IN INSANITY. FREDERICK PROESCHER and ALBERT S. ARKUSH, Am. J. Psychiat. **10**:245 (Sept.) 1930.

After a statistical study of the serology and the clinical semiology of patients with mental disease, Proescher and Arkush conclude that, except in dementia paralytica and cerebrospinal syphilis, no direct relationship exists between syphilis and insanity. In their series of cases, 5 per cent of men and 2 per cent of women, omitting patients with dementia paralytica, had syphilis. They believe that popular prejudice on this subject overestimates the importance of syphilis in mental disease.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY AND THE NEW YORK ACADEMY OF MEDICINE, SECTION OF NEUROLOGY AND PSYCHIATRY

Joint Meeting, Jan. 13, 1931

MICHAEL OSNATO, M.D., *Chairman, in the Chair*

A CASE OF PELLAGRA WITH NEUROLOGIC MANIFESTATIONS. DR. THOMAS K. DAVIS.

The patient in this case from the neurologic service of Bellevue Hospital was a young child. For that reason and since the striking symptoms as well as the dermatitis have disappeared, the patient himself was not shown. There was nothing remarkable in the familial or the early infantile history of the child and nothing in the previous medical history except the slowly arising features of the illness under discussion. The feeding of the child had always been difficult, and he had usually refused meat. Another child, later diagnosed as pellagrous, lived in the same household for some time. In May, 1929, approximately, the patient was taken to live in New Mexico, and shortly thereafter he had an erythematous rash on those portions of the skin that were exposed to the sun, namely, the face, the hands and the feet. This condition remained essentially the same, though the dermatitis cleared up at these points when stockings were used to keep the dorsal surfaces of the feet and the shins from exposure. However, in late October or early November, 1930, a similar rash arose for the first time at sites where there was no exposure to the sun, namely, the dorsal surface of the penis, the inner and the upper aspects of each arm and the inner aspect of each thigh near the groin.

Beginning in the early fall, 1930, approximately two months before the boy came to New York, incoordination affecting both arms and both legs, tremors, marked irritability and a tendency toward polydipsia and polyuria gradually developed. On at least two occasions he had falling attacks, with no convulsive movements, but apparently with some alteration of breathing, circulation and consciousness. The child became incontinent of both urine and feces. There was no intellectual deterioration.

Examination showed a well nourished and well developed boy, aged 3, with an ataxic gait; slight ataxia in the finger-to-nose tests; coarse tremors of both hands and occasional fine myoclonic movements of the arm or the shoulder; hyperreflexia of the deep reflexes; negative Babinski sign; absent abdominal reflexes; normal conditions in the domain of the cranial nerves with the exception of an interesting ataxia of speech, and clear fundi throughout. It was impossible to obtain the sensory status beyond knowing that all parts of the body, including the perianal sacral segments, were sensitive to pinprick. The patient showed low grade stomatitis and glossitis, and symmetrical, coppery red, keratosic dermatitis in the areas already mentioned. He showed marked abdominal distention. Mentally, there was a strange mixture of querulousness and willingness to cooperate. While he was alert and not deteriorated, he showed at first a pathologic kind of perseveration. His intelligence test gave an intelligence quotient of 80 (Terman test score), denoting average intelligence. Examination of the blood showed: normal blood counts; normal chemical composition (urea, 18.8; uric acid, 3.9; sugar, 0.080 per cent; calcium, 11.8); a negative Wassermann reaction; coagula-

tion time, four and one-half minutes, and platelet count, 230,000. Urinalysis showed: color, yellow; acid reaction, clear; specific gravity, 1.030; a faint trace of albumin, later, none; sugar, negative; no blood or casts; (test for red blood cells, 91 per cent in two hours). The spinal fluid showed: no cells; globulin, negative; colloidal gold, 0; 24 mg. of protein; a negative Wassermann reaction. The feces were strongly positive for blood, but free from ova and parasites. The gastric analysis showed free hydrochloric acid, 23; total acidity, 47. Roentgen examination gave normal results, with a negative gastro-intestinal series.

The diagnosis of pellagra was concurred in by several of the physicians who had had experience with this disease in the South. The pediatric consultant and one skin consultant also agreed with the diagnosis. There had been a previous adverse opinion of another dermatologist who believed that he saw a dermatitis medicamentosa. This diagnosis was not accepted, as the child had had the skin condition for almost a year before he was given drugs of any kind. The most important clinical confirmation of the diagnosis was afforded by the course in the hospital.

Under the dietetic treatment with meat juice, tomato juice and brewer's yeast, the eruptions of the skin cleared up entirely, as did the stomatitis and the abdominal distention. The patient lost the ataxia almost completely; he no longer showed tremors and was considerably less irritable. He continued incontinent of both urine and feces, but this feature will probably also disappear.

This case was presented as one with toxic changes in several probable sites, chiefly the midbrain and the spinal cord, and probably the posterior columns. These changes were considered secondary to the presence of pellagra.

KÜMMELL'S SPONDYLITIS. DR. E. D. FRIEDMAN.

C. Y., an Italian blacksmith, aged 40, was admitted to the neurologic service at Bellevue Hospital on Nov. 5, 1930. The patient understood little English, and the history was obtained with difficulty. The chief complaint on admission was inability to walk. The family history was irrelevant. A primary lesion had occurred twenty years prior to admission. The patient had little treatment at that time, but in August, 1926, he had six intravenous injections of arsphenamine. Two years prior to admission, he received thirty-eight injections into the buttocks. Five years prior to admission, the patient cut his wrist, and since that time he had exhibited ulnar deviation of the right hand. He was well until four years prior to admission. While riding a bicycle, he was struck by an automobile. At that time he sustained a laceration of the left eyebrow and contusions of the left shoulder. There was no period of unconsciousness. He remained in bed about twelve days. Since then he had noticed progressive weakness of the left lower extremity and numbness in the left leg. Eight days prior to admission, he suddenly experienced pain in both lower limbs and grew progressively weaker. There were no bladder symptoms. He had noticed wasting in both legs, in the left more than in the right. He had also lost 30 pounds (13.6 Kg.) in the past six months.

Neurologic examination showed that the pupils were equal and regular, and that they reacted to light and in accommodation. The fundi were normal. There was no field defect. The corneal reflexes were present and equal. Other cranial nerves showed no abnormalities. There was a paraparesis, greater on the left, with some atrophy. The patient could walk, but he had to be assisted. Sensation in all forms was normal throughout. The biceps, triceps and radial jerks were present and equal; the knee and ankle jerks were hyperactive. There were transient patellar and ankle clonuses; there was a suggestive Babinski sign, more definite on the left than on the right. The abdominal and cremasteric reflexes were absent. No scotomas were demonstrated.

Lumbar puncture revealed clear, colorless fluid; there was no evidence of block and no cells; the Wassermann reaction was negative; the colloidal gold curve was 1221000000; the total protein was not increased; there was no globulin: sugar was present.

An examination of the urine gave negative results; there were no Bence-Jones bodies. No primary focus of a malignant condition was demonstrable.

Roentgen examination revealed the following: The lungs showed adenopathy at both roots. The spine showed moderate compression of the bodies of the third and fourth dorsal vertebrae with diminution in width of the intervertebral point space.

Owing to the history of trauma, the absence of clinical evidence of tuberculosis or primary malignant disease, the case was diagnosed as Kümmell's spondylitis.

DYSTROPHIC DYSGRAPHIA. DR. SAMUEL BROCK.

In October, 1930, a schoolboy, aged 11½, came under my observation in the neurologic service of the Bellevue Hospital. In the fall, 1929, he began to notice difficulty in writing. For a time the condition improved but it later became aggravated. Little progress occurred during the fifteen months that had elapsed since the onset. The past history was entirely irrelevant. The boy was right-handed.

A neural examination revealed a lessened swing of the right upper extremity and a tremor and, at times, a jerkiness of the outstretched right hand, associated with a downward sloping of the hand at the metacarpus. The palm of the upstretched right hand was slightly pronated (Wilson's sign). When the patient attempted to write, he grasped the pencil normally, but as he formed letters the muscles of the right hand and forearm were beset by tremor and spasm. The parents noted that the right hand and forearm did not function as smoothly as previously in the movements involved in eating. There was some slight difficulty in buttoning and unbottoning the clothes. He was able to throw and catch a ball with ease. There was no forced grasping or groping. No spasm or tremor was otherwise noted, nor have I observed any other maneuver accompanied by unusual hypertonus. No play of hypotonus to hypertonus was found. No weakness was demonstrated by dynamometer tests or otherwise; in fact, the rest of the neural status was normal. The patient had practiced drawing and writing with the left hand and he did exceedingly well. The boy was an active schoolboy who made no complaints. No neurotic attributes were disclosed.

To my surprise, a sister, B. J., aged 16, the only other sibling, a college girl (also right-handed), suffered from the same condition. She had the "writing spasm" for four years with no progress of the disease to newer parts. As in her brother's case, an examination disclosed a much lessened swing of the right upper extremity, the sloping hand, with radial deflection and tremor of the outstretched hand, a right pronator sign (Wilson) and the spasm and tremor on writing. She found that she could write better if she caused the hand to curl on the forearm at the wrist, rotation taking place on the ulnar border of the hand, so that the tip of the pencil pointed toward the body. The parents noted this same curling of the right hand on the forearm in the movements of the extremity incidental to eating. Twelve years previous to examination, at the age of 4, she had a left facial paralysis of the peripheral type. The left side of the face at the time of examination showed the slight contracture so often noted in Bell's palsy after the weakness has disappeared, together with an occasional twitch of the perioral muscles on the left. As in her brother's case, the rest of the neural status was normal. Like her brother, she had no pain, nor were there any symptoms of a neurotic character. She too made light of the disease. She is successfully pursuing a college career.

There can be no doubt of the organic nature of these cases when one considers the signs. Dystonic disorders of motility brought on almost solely by volitional effort have been described before (Goodhart, S. P.; Wechsler, G. S., and Brock, S.: Remarkable Extrapyramidal Involuntary Movements, ARCH. NEUROL. & PSYCHIAT. **21**:1299 [June] 1929). While I have seen this sort of

difficulty in writing in definite cases of dystonia musculorum deformans, I have never been confronted with such a seemingly nonprogressive fractional and familial form.

To this most unusual fragmentary dystonic disease I have applied the term "dystonic dysgraphia," disavowing any desire, however, to do more than give a convenient label to what seems a rare condition. The relation of this condition to the commoner cases of "writer's cramp," and the organic lesions in the basal ganglia (?) or elsewhere that underlie this condition are interesting subjects for speculation.

TORTICOLLIS AND THE RIGHTING REFLEXES AND TONIC REFLEXES OF THE NECK (MAGNUS). DR. SAMUEL BROCK.

J. O., a man, aged 44, was presented from the neurologic service of Bellevue Hospital. His illness began about twelve years previous to presentation, one year after a motorcycle accident. The head turned to the left. At first a feeling of stiffness and a slight tonic contraction of the muscles of the neck were noted. For about eleven years the condition was not pronounced or incapacitating, but about a year prior to presentation it became considerably worse. He was referred to an able psychiatrist who searched for psychogenic factors. The patient was successfully hypnotized a number of times, but after an ample period of investigation the psychiatrist rightly concluded that the condition was organic.

The patient's head turned in a tonic movement with the chin directed to the left, downward and forward. A coarse clonic movement was superimposed on the tonic torticollis. When the movement was checked, the former element took on a tremor-like quality. If an object or the hand was lightly placed on the back of the head, or on the left side of the face or on the back of the neck, the movements were greatly reduced. This has been observed many times in cases of torticollis, but I wish to stress the probability that this maneuver belongs in the sphere of the righting reflexes, described by Magnus, of the type known as "body surface acting on the head" and so diminishing the movements. When this patient bends the head forward, the movements are definitely made worse, especially the clonic phases. I believe that this may be an evidence of the implication of some tonic reflex of the neck in the Magnus sense.

I do not know how tonic reflexes of the neck or righting reflexes are related physiologically to torticollis. However, these clinical observations are supported by the results of an operation in which the spinal accessory nerve of the active side and the four upper posterior cervical roots of the opposite side are transected. During his recent visit to America, Foerster showed some photographs of sufferers from torticollis who were benefited by this operation. Attention may be called to the fact that cutting the four upper cervical roots interferes with the transmission of impulses from the muscles and the tendons of the neck, from which source tonic reflexes of the neck are activated.

A TUMOR OF THE POSTERIOR CORPUS CALLOSUM. DR. GEORGE H. HYSLOP.

Tumors of the corpus callosum are rare and are seldom diagnosed clinically. The involvement of the posterior corpus callosum and the lateral spread into both cerebral hemispheres led to symptoms in this case, from the neurologic service of Bellevue Hospital, that were confusing. The histologic type of glioma represented in this case, namely, astroblastoma, is also uncommon. In Cushing's series of 254 verified and classified gliomas, there were 13 astroblastomas. Astroblastomas are usually subcortical and slow in growth.

The patient was a woman, aged 57, in whom the symptoms appeared definitely following an attack of influenza in December, 1929. Reversal of the mechanism of sleep, diplopia, forgetfulness, headache and fatigue were the prominent symptoms. A low grade fever was present from early in January until death in April, 1930. In March, pupillary disturbances were noticed, as well as impairment of conjugate upward movements of the eye. Early in April, severe neuroretinitis with slight

papilledema suddenly developed. Additional significant symptoms which were not properly evaluated consisted of occasional sudden and momentary inability to stand erect and walk, and a peculiar transient paralysis of voluntary movement in one arm or the other. These symptoms have been observed in tumors of the corpus callosum. However, the other symptoms and the presence of fever so strongly led to a diagnosis of epidemic encephalitis that the phenomena related to the corpus callosum were disregarded.

Fluctuations in the patient's symptoms were frequent during the course of the illness, which ended in April, 1930. Neurologic examination did not reveal any clearcut evidence of focal disease of the brain, except for signs in the pupil and in the muscles of the eye which suggested involvement of the upper portion of the midbrain. Complete laboratory investigation gave negative results except for a mild leukocytosis in the blood, and the spinal fluid was under moderately increased pressure (about 200 mm.), with from 12 to 20 cells, slight xanthochromia, increased sugar content and a positive colloidal gold curve. Careful roentgen examination of the skull gave negative results.

At necropsy, the uncut brain showed cortical engorgement and discoloration and some softening of the right midparietal cortex which was probably caused by a neoplasm. After the brain was hardened, it was sectioned, and it was found that a diffuse infiltrating tumor was present in the posterior part of the corpus callosum extending laterally into both hemispheres with destruction of a large part of the subcortical region. Areas of necrosis were evident. In the right hemisphere the tumor tissue extended as far as the cortex in the midparietal region. There was no dilatation of the ventricular system. The corpus callosum in its posterior aspect was enlarged and pressed down and forward against the upper portion of the pons and the midbrain.

Microscopic examination of the tumor tissue demonstrated typical astroblasts in abundance, with the characteristic loose structure.

Differential Section of the Dorsal Root of the Trigeminal Nerve.

Dr. Byron Stookey.

Trigeminal neuralgia may involve one division for a number of years and only late in its course show secondary involvement of one or both of the remaining divisions. In such instances my colleagues and I have designated the division first involved as the primary and the divisions into which the pain radiated later as the secondary, i. e., trigeminal neuralgia of the primary mandibular division with secondary radiation into the maxillary.

Years ago, when doing alcoholic injections for trigeminal neuralgia, it was observed that injection of the division primarily involved frequently gave complete relief from pain not only in the division injected but also in the division into which the pain had radiated secondarily. I applied this observation to section of the dorsal root of the trigeminus and for a number of years have attempted to cut the fibers of the dorsal root derived from the division primarily involved, saving the fibers from the divisions secondarily implicated. This procedure is in reality, therefore, differential section of the dorsal root.

Since the fibers of the dorsal root are not segregated into separate divisions with anatomic landmarks, identification of the bundles derived from each division can be only approximately determined, and is subject to certain variations dependent on the experience of the operator. It may be said in general that the lateral third is made up of fibers from the mandibular, the medial third of fibers from the ophthalmic and the middle third of fibers from the maxillary nerves. The latter fibers are the most difficult to identify since section of these alone can rarely be made without section of some of the adjacent ophthalmic or adjacent mandibular fibers. However, fairly accurate section of the fibers of the ophthalmic and mandibular divisions can be made, and, with greater operative experience, I believe that more accurate differential section can be accomplished. Fortunately, involvement of the ophthalmic division alone is relatively rare.

In a fairly large number of instances of primary mandibular pain, section of these fibers in the dorsal root has given complete relief from pain with a minimum of sensory loss, as in the case of the patient presented this evening on whom a differential section was done, and who now shows normal sensation over the face in the domain of the ophthalmic and maxillary divisions with retention of the corneal and nasal reflexes. The loss of sensation corresponds essentially to the mandibular division. The motor division was saved, and no atrophy of the muscles of mastication is present. (Neurosurgical presentation from the Bellevue Hospital.)

CHORDOTOMY OF THE SECOND CERVICAL SEGMENT FOR RELIEF FROM PAIN DUE TO RECURRENT CARCINOMA OF THE BREAST. DR. BYRON STOOKEY.

Since chordotomy for relief from pain caused by inoperable and recurrent tumors was first suggested by Spiller and the first operation was performed by Martin, a number of these sections of the spinothalamic tracts in the thoracic region of the spinal cord have been done. The operation has generally been considered of special value in inoperable tumors involving the lower segments of the body in which section of the spinothalamic tracts in the thoracic cord could be done. This procedure has not been considered generally applicable to tumors of the breast or to the higher segments of the body, since section into the cervical segments near the medulla would be required. It has frequently been said that section into the uppermost cervical segments of the spinal cord for intramedullary tumors is likely to be followed by ascending softening of the spinal cord with involvement of the medulla and that therefore this procedure is contraindicated. For a number of years I have accepted this statement and refrained from section of the cervical region of the cord. Nevertheless, in several instances I have been compelled to split the cord in attempts to remove intramedullary tumors from the upper cervical region. This has been done without untoward effects. With these examples in mind, it seemed worth while to attempt section of the spinothalamic tracts in the second or third cervical segments of the spinal cord for relief from pain caused by inoperable and recurrent carcinoma of the breast.

The patient in this case had a unilateral chordotomy of the spinothalamic tracts at the second cervical segment. Since the operation she has had complete relief from the pain caused by recurrent carcinoma of the breast. In a second patient, I recently sectioned the pain tracts of both sides at the second and third cervical segments, with relief from pain and without development of medullary signs.

Chordotomy in the uppermost cervical segments will extend the usefulness of this operation to include relief from pain resulting from pathologic processes that involve the upper segments of the body; these processes have generally been considered beyond the scope of chordotomy. (Neurosurgical presentation from the Bellevue Hospital.)

GAS POISONING WITH A DYSTONIC FRAGMENT. DR. FOSTER KENNEDY.

C. L., a chauffeur, aged 37, from the neurologic service of Bellevue Hospital, presented difficulty in speaking, chewing and swallowing, involuntary facial grimaces and involuntary opening of the mouth for ten months prior to presentation. He noticed, in December, 1929, that his mouth would open against his will; chewing became difficult; stuttering occurred, and he had difficulty in swallowing. The last symptom was produced by the mouth opening involuntarily when he was about to pass food into the esophagus. The symptoms ceased during sleep and were usually absent for perhaps fifteen minutes after waking. He had lost over 40 pounds (18 Kg.). The symptoms were less marked under excitement. The movements of the lower jaw were often constant and "fishlike." The speech was normal, except for the difficulty produced by the movements of the jaw. For some months before the onset of the symptoms, the patient drove a truck in which the exhaust led into an enclosed area around the driver. He stated that he was constantly aware of breathing the fumes from the exhaust. He complained of smarting eyes and headaches. In view of the absence of a history of any condition resembling

encephalitis, it was suggested that the movements were release movements due to degeneration in the corpora striata produced by chronic carbon monoxide poisoning.

DYSTONIA MUSCULORUM DEFORMANS. DR. FOSTER KENNEDY.

A boy, aged 8, presented a shuffling backward gait which was noticed when he began to walk at 3 years of age. He always fell easily. The history of his birth related that the pains were never strong, high forceps were used, and the child was in an abnormal position and was born in white asphyxia; a mark left by the forceps was seen over the left parietal area. The patient presented a characteristic picture of dystonia musculorum deformans. There were involuntary movements in the arms and the legs; they were slow and followed a constant pattern. There was repeated extension of the head and contraction of the sternocleidomastoids. The arms were repeatedly extended, with internal rotation. There was also some torsion of the trunk and the pelvis. The patient walked with the body flexed forward at the hips until the torso was at right angles to the thighs. He splinted his body by supporting himself with the right hand on the right knee. The left hand was in the typical internally rotated extended position. He could thus walk unaided, but was in constant danger of falling because of jerking movements of the body, which tended to upset his balance. The speech was explosive, blurred and staccato. The intelligence was normal. The emotional nature fluctuated between extreme cheerfulness and extreme irritability and depression. There were no signs in the pyramidal tract; the entire picture resulted from striatal degeneration.

SENSORY CONDUCTION IN THE PERIPHERAL NERVOUS SYSTEM. DR. S. W. RANSON, Northwestern University (by invitation).

This article will be published in full in a later issue of the ARCHIVES.

THE ANATOMIC BASIS OF SYMPATHECTOMY. DR. ALBERT KUNTZ, St. Louis University (by invitation).

Operative procedures commonly known as sympathectomy may involve extirpation of a portion of the sympathetic trunk, section of the rami connecting the sympathetic trunk with certain of the spinal nerves, section of the sympathetic nerves distributed to the internal organs, or merely section of a periarterial nerve plexus. The aim of such operative procedures is complete or partial sympathetic denervation of the part or the organ involved.

The sympathetic trunks are functionally connected with the central nervous system through preganglionic visceral efferent fibers which reach it through the anterior roots and visceral rami of the spinal nerves from the first thoracic to the second or third lumbar inclusive. These fibers terminate in synaptic relationship with ganglion cells in the sympathetic trunks and other sympathetic neurons located nearer certain of the internal organs. Fibers arising in the ganglia of the sympathetic trunk join all the spinal nerves via their visceral rami, to be distributed through the somatic rami of these nerves to the peripheral blood vessels, sweat glands, erector pili muscles, etc. Sympathetic fibers likewise extend from the superior cervical sympathetic ganglion, located at the upper end of the sympathetic trunk, through the internal carotid nerve, into the cephalic region. Nerves arising from the sympathetic trunk also supply the internal organs.

Section of all the rami connecting certain of the spinal nerves, e. g., the nerves involved in the brachial or the lumbosacral plexus, or extirpation of the corresponding ganglia of the sympathetic trunk, obviously eliminates the sympathetic nerve supply in the area of distribution of these nerves. Since all the preganglionic fibers that terminate in the cervical sympathetic ganglia reach the sympathetic trunk in the thoracic segments, extirpation of the inferior cervical ganglion also paralyzes the sympathetic nerves arising from the middle and superior cervical sympathetic ganglia. Since no preganglionic fibers join the sympathetic trunk below the second or third lumbar segment, extirpation of a portion of the lumbar sympathetic trunk, including the second, third and fourth lumbar ganglia, likewise insures complete denervation of the lower extremity.

The vasomotor nerve fibers supplying the peripheral blood vessels, like the sympathetic fibers that are distributed to other peripheral structures, traverse the somatic rami of the spinal nerves. The periarterial plexuses contain relatively few fibers that extend distally along the arteries for more than a short distance. Periarterial sympathectomy, therefore, does not eliminate the vasomotor innervation of the more distal parts of the arterial tree.

Contrary to the current conception, the gray rami through which sympathetic fibers join the spinal nerves involved in the brachial and lumbosacral plexuses also contain afferent fibers. Any operation, therefore, that effectively eliminates the sympathetic innervation of an extremity also divides a certain number of afferent fibers.

The most important effect of sympathectomy is complete or partial elimination of the nervous control of the smooth muscle in the area affected. The tonus of the blood vessels is reduced by reason of vasomotor paralysis, and an increased supply of blood to the tissues is insured. This, doubtless, is a major factor in the improvement reported following sympathectomy in cases of chronic polyarthritis and allied conditions. Relief from vascular spasm and the associated pain in cases of Raynaud's disease, following sympathectomy, must also be regarded mainly as the result of vasomotor paralysis. The beneficial results obtained by sympathectomy in certain cases of angina pectoris probably result, at least in part, from partial vasomotor paralysis of the coronary arteries. In view of the data available at present, however, it cannot be maintained that sympathectomy in the treatment for angina pectoris rests on a rational basis.

To what extent relief from pain following sympathectomy, reported particularly in cases of polyarthritis, thrombo-angiitis obliterans, etc., is brought about by the division of afferent fibers cannot be stated at present. The relief or amelioration, following sympathectomy, of the conditions that produce the peripheral stimulation doubtless plays an important rôle in the relief from pain.

DISCUSSION

DR. BYRON STOOKEY: It is mainly owing to the anatomic studies made by Dr. Kuntz that surgical measures on the sympathetic nervous system for relief from vasomotor spastic states in the upper extremities have proved successful. Before his anatomic contributions, the operation was not infrequently done incompletely, because surgeons did not know about the branch that Professor Kuntz was the first to describe that passes from the second to the first thoracic nerve and carries vasomotor fibers to the upper extremities. Leaving this communication intact naturally made an incomplete and therefore an unsuccessful operation. Pointing out the importance of this branch has enabled surgeons to make complete and successful operation.

For a number of years I have been teaching the fallacy of perivascular sympathectomy, and in my book, published in 1922, a critique of this procedure will be found in which I called attention to the fact that perivascular sympathectomy is a relatively valueless procedure, and that it does not rest on sound anatomic grounds. That procedure, I am glad to say, is largely discarded for the more complete operation of ramisection or sympathectomy.

I am also interested in Professor Kuntz' comment that fibers leave the second to fifth thoracic segments to go directly to the cardiac plexus. This is as important a contribution as was the demonstration of the branch from the second to the first thoracic nerve, since operations for angina may not be successful unless a more complete procedure is evolved.

Sympathectomy for Raynaud's disease and for certain forms of polyarthritis afford the best opportunity for relief that surgical measures on the sympathetic nervous system can offer, since in both these conditions there is vasomotor spasm. Section of the postganglionic fibers causes paralysis of the smooth muscles and, therefore, dilatation of the vessel wall. By this means a patient with polyarthritis is given permanent vasodilatation, such as is obtained for only a few minutes by hydrotherapeutic measures.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, Jan. 15, 1931

SIDNEY D. WILGUS, M.D., *President, in the Chair*

LARYNGEAL VERTIGO AND ITS RELATION TO CATAPLEXY. DR. J. GORDON WILSON (by invitation).

Cases of laryngeal vertigo are relatively infrequent. The symptom-complex places it among borderline cases which might as readily be treated by the neurologist as by the laryngologist. Its etiology raises the question of a laryngeal or respiratory reflex. The cases recorded convince one of the vagueness of the term laryngeal vertigo. It has been used as a label to group diverse phenomena showing some similarity in one or more symptoms. The term vertigo is a misnomer; in no case has true vertigo been shown to have been present. In laryngeal vertigo the fundamental characteristics of the symptom-complex are: (1) the sudden fall of the patient to the ground, and (2) the brevity of the attack, the patient often recovering in less than a minute. Recovery is complete. Loss of consciousness during the attack does not always result. No pathologic lesion is present in the larynx as a rule, certainly none with any distinct or special significance.

In 1876, Charcot first directed attention to a rare sequence of symptoms that he called laryngeal vertigo, and in 1879, he published four cases, of which the outstanding characteristics were: (1) a cough, severe or slight; this was preceded in three of the cases by a tickling of the larynx; (2) falling to the ground, with or without loss of consciousness and without convulsive movements, and (3) rapid recovery — the patient would get to his feet within a few seconds of falling without dulness or confusion of intellect.

Though the term laryngeal vertigo still persists in textbooks, it early met with opposition from those who reported analogous cases described under other and diverse names, for example, spasm of the glottis in the adult, a rare form of laryngeal neurosis, laryngeal epilepsy and laryngeal ictus.

In the case here presented the sequence of symptoms was: (1) while drinking water the patient would have a feeling of contraction of the throat and would fall to the floor; (2) he would rise before anyone could reach him (rapid recovery), and (3) he would recover completely, without fatigue.

S. A. Kinnier Wilson defined cataplexy as "A peculiar proneness to the development of a transient condition of physical powerlessness under the influence of emotion, so that the patient's knees give way and he may sink to the ground without any loss of consciousness." The symptoms of laryngeal vertigo are closely akin, if not identical in many cases, with those of cataplexy, but there is no narcolepsy.

The following hypotheses have been advanced to account for laryngeal vertigo: epilepsy (petit mal), a valsalva reaction, a disturbance of cerebral circulation from intrathoracic pressure, a modification of cerebral cardiac circulation by reflex irritation though the vagus nerve on cardiac centers, and a disturbance of the equilibrium of vascular and cerebrospinal tension.

It may be noted that in every case the phenomena that introduce the symptoms of laryngeal vertigo are associated with closure of the glottis or laryngeal aperture with a resulting momentary arrest of respiration; therefore, a laryngeal or respiratory reflex offers the most satisfactory hypotheses.

DISCUSSION

DR. LEWIS J. POLLOCK: It may be of interest to recall that not only is there a seeming direct relation between the mechanisms of respiration and the

static-tonic mechanism, but there seems likewise to be an intermediary relationship through metabolism, as, for example, in the cases of postencephalitic hyperpnea in which tetany frequently results, followed by loss of consciousness. It is also interesting to note that one of the strongest stimuli of respiration that has been found in animal experimentation arises from stimulation of the soft palate. It is difficult to understand why the apperception of the emotion alone is sufficient to produce a cataplectic attack, and why the mechanism of laughing without the apperception of emotion is said by S. A. Kinnier Wilson to be insufficient to produce cataplexy.

DR. GEORGE W. HALL: The case that Dr. Wilson has reported is interesting, and while many of us come in contact with such cases we have not interpreted them as such. There are a good many neuroses that may to some extent resemble the condition that Dr. Wilson has described. I have had one patient who was extremely neurotic and had great fear of swallowing water. She had become dizzy on several occasions when attempting to take a swallow of water, and only through constant training was she able to swallow water in any quantity at a time. She has had no genuine cataplectic attacks. It seems to me that Dr. Wilson's approach to an explanation is a most logical one, because of the close connection between the fibers of the vagus and Deiters' nuclei.

DR. G. B. HASSIN: I have not had personal experience with cases of cataplexy. In listening to Dr. Wilson's paper, I received the impression that some of the cases he quoted were epilepsy. Some symptoms such as aura, sudden loss of consciousness and the paroxysmal occurrence of the attacks, which were always alike, were suggestive of epilepsy. The seizures were not typical, so-called complete epileptic attacks, and I would call them incomplete epilepsies. In talking to Dr. Wilson this evening, I remarked that I shall try to look up a book by Herpin, published in 1867, which I read about ten years ago. In his book, Herpin gathered a number of obscure cases that ultimately proved to be epilepsy. I am sure that among the numerous cases recorded by him, some of which he followed up for many years, some began with vertigo and laryngeal manifestations. Ultimately they proved to be frank cases of epilepsy, of which the vertigo was only a manifestation. Probably many of the cases of cataplexy could be classified as Herpin's incomplete type of epilepsy.

SPASMODIC TORTICOLLIS. DR. GEORGE B. HASSIN.

This article will appear in full in a later issue of the ARCHIVES.

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Jan. 15, 1931

E. WYLLIS TAYLOR, M.D., *President, in the Chair*

THREE CASES OF MALINGERING IN PERSONS ACCUSED OF CRIME. DR. ABRAHAM MYERSON.

The criteria of malingering are not easy to establish in the field of psychiatry, especially since so many of the clinical syndromes have no physical or biologic signs by which they can be detected. The diagnosis in many cases of mental disease is difficult, so that even in undoubted psychoses, equally well trained men will differ in classification and understanding. Abnormal conduct and abnormal speech may be simulated, and yet a genuine psychosis may have a histrionic exaggeration, which in a prisoner accused of a crime for which punishment ranges from long imprisonment to death will lead to the conclusion that he is malingering.

Malingering is, on the whole, rare in men and women accused of crime. In the routine examination of prisoners, which is carried on in Massachusetts under the provisions of the Briggs' law, it is a common reaction for the prisoner to say with scorn or amusement, "I am not bughouse and I don't want any one to say I am." Yet it can easily be seen that some would rather be considered insane than be electrocuted, and that occasionally a person may be encountered for whom it would be more tolerable to be regarded as sick in the mental sense than as a disgrace to his family.

The questions that I ask myself when faced with the problem of answering whether what seems to be a psychosis in an indicted or convicted man or woman is genuine or not, are few, but I think that they are critical and practical: 1. Did the crime arise under circumstances that can be explained by sane, if criminal, motives? Thus, murder while robbing involves no forensic psychopathology; nor does stealing from one's employer, nor skilful defalcation by a bank treasurer over a long period of time. If the crime involves unusual motives, as in cases of aberrant sex reactions or murder by some one who is a stranger, then a psychosis is understandable. 2. Does the clinical picture presented by the prisoner hang together? Thus, an amnesia is always to be distrusted if it happens without violence or injury. A sudden deterioration is to be regarded with suspicion, unless definite physical signs of some type accompany it. Usually, as in the cases here reported, there is marked disharmony which can be shown up by a technic that throws the prisoner off his guard. Rarely does the pretended deterioration go so far as personal habits, and the intact personality throws off the mask now and then. It is necessary to have a watch so placed on the prisoner that he can be observed without knowing it. His conduct when visited by his lawyer or his own people becomes of great importance for the diagnosis of malingering.

Case 1.—A young woman of respectable family was indicted for having stolen about $20,000 from her employers by falsifying the books. She became depressed when arrested, and on examination claimed that a man followed her everywhere, that he had been doing so for several years. Her conduct during the time she was working showed no signs of any such delusion or hallucination, and the skill of her peculations was out of harmony with a delusion of this type, which usually goes with schizophrenia. She behaved quite differently when alone than in the presence of a physician. When on trial, she reacted normally on the witness stand. After a period of probation she found employment, worked industriously and skilfully, and obtained the confidence of her new employer. It was recently discovered that she has stolen thousands of dollars by a very ingenious method.

Case 2.—C. T., a very desperate young robber, was sent to the state prison for robbery while armed. He succeeded in getting transferred to a part of the prison from which escape was remotely possible, obtained a gun by some means, killed one guard and seriously injured another before he was frustrated in a coolly planned but desperate attempt to escape.

He was examined under the Briggs' law, found not insane, tried and sentenced to death. Shortly before the time set for his electrocution, one of the two psychiatrists who had examined him announced his belief that C. T. was not responsible, giving as his reasons that the prisoner was deteriorating, and also that he came of a low grade family and never had a chance to learn a real morality; the latter fact is not relevant in the present state of the law.

When he was examined, the prisoner whispered, grinned foolishly, had lost all information, laughed and talked to himself. This was in gross contradiction to his conduct in his cell, as testified to by guards, the warden, the prison physician and chaplain, and others. Moreover, by a little technic, he was moved to justify his murder, and for a minute or two forgot to act his part and became forceful, coherent and a bold, vainglorious justifier of his act; then he lapsed back into his portrayal of an idiot. We declared him a malingerer, and he dropped his mask, going to death with the same bold egoism manifested in his criminal career.

Case 3.—E. S., a highly respected member of a small Massachusetts community and the treasurer of the local bank, stole $40,000 of the bank's money during a

period of years by altering deposit slips. This was discovered purely by accident, while he was on a vacation. When questioned about the matter he had a loss of memory and a confused, depressed air. While out on bail, he was sent to a hospital for mental diseases, and after a month's observation was declared to be insane and suffering from arteriosclerotic dementia. He showed a marked loss of memory for recent events, and was unable to hold four numbers in mind. On the basis of the memory tests he had a mental age of about 4 or 5 years, two months after he had been head of a banking institution and had cleverly manipulated its books.

This disharmony became glaring when we examined him at his home. His ingrained habits of courtesy made him play the genial host, so that he even anticipated our needs. His pride in his heirlooms, which was purposely aroused, led him to a clearcut, detailed history of certain fine cups, which stood on the mantel-piece. His inability to repeat 4 7 3 1 did not keep him from comprehending some questions as to memory, which were purposely couched in long, polysyllabic, complex sentences. He was declared to be malingering, on the basis that his deterioration was too rapid and out of harmony with his intact personality. He was sentenced to the state prison, and we are informed by the Commissioner of Correction that he fills a responsible and high grade position in that institution in an efficient fashion.

NONTRAUMATIC OSTEOMYELITIS OF THE FLAT BONES OF THE SKULL. DR. DONALD MUNRO.

1. Nontraumatic osteomyelitis of the flat bones of the skull is a rare surgical condition. Only 221 cases were collected from the literature. 2. Pathologically, it is fundamentally a condition of rarefying destructive osteitis caused by a spreading infection of the diploic vessels and their tributaries. 3. It occurs almost exclusively in association with diseases of the paranasal sinuses and the tympanomastoid region. Operative procedures on these structures have no influence on its causation. 4. The diagnosis is obligatory following the demonstration of pus enclosed between either the periosteum or the dura and the diploic bone. 5. Meningitis, "no complications" and thrombosis or infection of the cranial venous sinuses and of other cranial veins are the commonest complications of the disease. 6. Treatment should be early and radical. 7. The mortality rate is approximately 50 per cent; it is slightly higher in the cases in the frontal bone and slightly lower in the cases in which the temporal bone is involved. 8. Two cases of frontal osteomyelitis are reported which, after radical treatment, terminated in the death of one patient (mortality rate 50 per cent).

DISCUSSION

DR. G. HORRAX: I certainly agree that one must always do a radical operation. All the patients that I have seen who have recovered have had radical operations.

DR. D. GREGG: What is the mechanism of the epileptic attacks?

DR. D. MUNRO: I have no idea what causes the attacks. Perhaps the new bone caused a compression of the underlying brain over the frontal lobe, but I have no evidence to support that theory. The new bone consists of extremely small plaques, and the cerebrospinal fluid is normal.

DR. G. HORRAX: May the attacks not be caused by an inflammatory process, resulting possible adhesions, thickened arachnoid or fluid in the arachnoid space?

DR. STANLEY COBB: If the boy had anything of that sort, would there not have been at least lymphocytes in the spinal fluid?

DR. D. MUNRO: Examination showed a normal cell count, and a chemical analysis of the blood showed that it is normal. There is a lessening of the size of the arachnoid cavity, complicated by the presence of a normal amount of cerebrospinal fluid. I should imagine that if the absorptive area had been reduced, the boy would have developed a compensatory hydrocephalus.

CEREBROSPINAL FLUID AND SERUM CHLORIDES IN MENINGITIS. DR. FRANK FREMONT-SMITH and MARY E. DAILEY, A.B.

It is generally agreed that the normal value for chlorides in human blood serum, expressed as sodium chloride, is between 570 and 620 mg. per hundred cubic centimeters. In our experience the normal content of chloride in the cerebrospinal fluid varies between 715 and 745 mg. per hundred cubic centimeters. The higher content of chloride in the spinal fluid was explained by Mestrezat as compensating for the absence of protein and other colloid substances which are present in the plasma, giving the spinal fluid an osmotic pressure equivalent to that of plasma. Mestrezat's experiments demonstrated that the equilibrium between the serum and the spinal fluid across the choroid plexus is fundamentally the same as the equilibrium across a collodion membrane; this evidence is strikingly in favor of the theory that spinal fluid is a dialysate from blood serum.

The low content of chloride in the spinal fluid in meningitis was first recognized by Nobecourt and Voisin in 1903 (*Arch. gén. de méd.*, 1903, p. 3019). In 1912, Mestrezat, in his monograph (Le liquide céphalo-rachidien, Paris, A. Maloine, 1912), interpreted this observation as being due to a "local meningeal permeability" allowing equalization between the chlorides in the spinal fluid and in the plasma, the chlorides in the spinal fluid decreasing and approaching serum chlorides as the protein content in the fluid increased.

We do not agree that this increase in protein is sufficient to account for the very low chloride values found in meningitis. We plotted the chlorides in the spinal fluid against the protein content in a group of cases of meningitis. It is apparent that there is no correlation between the level of the chloride and the increase in protein, some of the highest chloride values being associated with a high content of protein and some of the lowest with a low content of protein. At the same chloride level the protein varied from practically normal to over 1,000 mg. per hundred cubic centimeters.

We plotted the protein against the chloride values in a group of cases with a high content of protein in the spinal fluid but without cellular increase or any evidence of meningitis; the fluids were such as are present in peripheral neuritis and in tumor of the cord. Here again there is no correlation between the decrease in chloride and the degree of increase in protein. An increase in protein of from 200 to 500 mg., which is most common in meningitis, is often associated in these fluids with normal or but slightly low content of chlorides.

In meningismus, in which there is normal or low content of protein and an otherwise normal fluid, the chlorides in the spinal fluid are frequently as low as those in meningitis.

The fluids from meningitic cases with an extremely low content of chlorides without much increase in protein, the fluids with a high content of protein and a normal content of chlorides, and the otherwise normal fluids with a marked decrease in chlorides are all evidence that the increase in protein is not the explanation for the low content of chlorides in the spinal fluid in meningitis.

In 1924, we stated that the diminution of serum chlorides which we found consistently in acute infections of the meninges was the most important element in lowering the spinal fluid chlorides (Fremont-Smith, F., and Dailey, M. E.: Cerebrospinal Fluid Sugar, ARCH. NEUROL. & PSYCHIAT. **14**:390 [Sept.] 1924). We have since confirmed, in a large series of simultaneous determinations of the chlorides in the serum and in the spinal fluid, that the chlorides in the serum are regularly low in meningitis. The low content of chlorides in the spinal fluid is a reflection of the low amount of chlorides in the serum. The protein content of the spinal fluid plays an insignificant rôle. Wilcox and Lyttle (Wilcox, H. B., and Lyttle, J. D.: (The Chemical Composition of the Spinal Fluid, *Am. J. Dis. Child.* **30**:513 [Oct.] 1925), Linder and Carmichael (*Biochem. J.* **22**:46, 1928) and Wright, Paul and Herr (*J. Clin. Investigation* **9**:443, 1930) have confirmed our observations.

Normal chloride values are found in tumors of the brain, abscesses of the brain and epidemic encephalitis. Normal values are strong evidence against meningitis.

Slightly low or normal values are found in syphilitic meningitis and acute anterior poliomyelitis. The extremely low values found in tuberculous meningitis (nearly always below 640 mg. per hundred cubic centimeters), together with the low level of sugar regularly found in that disease, should prevent confusion with abscess of the brain, epidemic encephalitis and acute anterior poliomyelitis. Clinically, this differential diagnosis is often most difficult.

Monrad-Krohn stated in the latest edition of his book that chlorides below 600 mg. per hundred cubic centimeters are found only in tuberculous meningitis. This is not true, for we have found such low values in pneumococcic and streptococcic meningitis with septicemia.

From the foregoing data we conclude that the low content of chlorides in the spinal fluid in meningitis is caused chiefly by a lowering of the chlorides in the serum. (From the Department of Neuropathology, Harvard Medical School.)

DISCUSSION

DR. J. B. AYER: Is there a parallelism between the decrease in the content of sugar and that of chlorides in meningitis?

MISS MARY E. DAILEY: Yes, usually; for instance, in meningococcic meningitis responding well to treatment, the content of sugar rises and the chloride also rises. If the case is progressing poorly, there is a progressive decrease in both. In meningismus, however, there is a normal amount of sugar with a low content of chlorides.

DR. J. B. AYER: Have you examined the blood in such cases of meningismus?

MISS MARY E. DAILEY: Yes. The chlorides in the blood plasma may be low and blood sugar may be normal or increased.

DEMONSTRATION OF A SKULL WINDOW: AN EXPERIMENT. THE EFFECT OF CAFFEIN ON CEREBRAL VESSELS. DR. STANLEY COBB, DR. HARRY FORBES and DR. JACOB FINESINGER.

The final part of the program was devoted to this experiment.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Jan. 23, 1931

WILLIAMS B. CADWALADER, M.D., *President, in the Chair*

CONVULSIVE STATE WITH UNUSUAL PATHOLOGIC CONDITIONS. DR. N. W. WINKELMAN.

An Irishman, aged 25, was admitted to the Philadelphia General Hospital on Nov. 14, 1927, and died on November 18. He was brought to the hospital because of confusion and mania following an epileptic seizure. It was learned that, nine years previously, he had fallen from a bicycle onto his head. About a year later, convulsions developed which were described as generalized and which recurred about every two weeks. One week before admission, he had what was characterized as "one of his usual convulsions." In a few hours after this he appeared to be normal, but soon became drowsy and fell into a deep sleep that lasted for four days and nights. He could be aroused, however, for nourishment, and he answered questions. He awakened and appeared normal and then in a short time became maniacal. He paced back and forth in his room, cursing and shouting. Restraint was necessary, and for twenty-four hours he was unable to sleep.

The patient was a twin; the other twin died in early childhood from an unknown cause. The patient had always been mentally below normal; his school career ended at 16, when he had reached the fifth grade.

Examination.—The following facts were of importance: The eyes were injected and lacrimating, and there was a slight downward and outward rotation of the left eye. The teeth were in a poor condition. Mentally, the patient was confused and disoriented, with visual hallucinations. He was delirious and obscene.

Neurologic examination revealed normal pupils. There was slight weakness of the left side of the face, and the tongue was said to deviate to the left. The reflexes were more increased on the right side, with a positive Babinski sign and ankle clonus on this side. It was impossible to test sensation. Laboratory examinations gave normal results in all respects.

Course.—While in the hospital, he had a generalized convulsion two days after admission. He showed active delirium until death, four days after admission.

Autopsy.—The organs of the body showed nothing abnormal except congestion. The brain likewise showed nothing abnormal grossly except moderate edema and congestion.

Microscopic examination revealed: (1) normal large blood vessels with hyalinized small blood vessels; (2) marked edema and congestion of the brain with edematous meninges that contained numerous phagocytic cells; (3) a fairly normal lamination in the cerebral cortex, with a few scattered cells that were typical of the so-called Schaffer cell process (there were not more than two or three in any low-power field); (4) many more cells of this same type in Ammon's horn; (5) the characteristics of the Schaffer cell disease in every cell in Sommer's sector; (6) confirmation in the Bielschowsky preparations of the observations made with toluidine blue stains and revelation of the same type of changes in the axis cylinders that are met with in this condition: ballooning out, irregularity and fragmentation; (7) a tendency in the cerebellum toward swelling of the cells, not only in the Purkinje layer but also in the dentate nucleus, but no indication of typical Schaffer cell disease.

Comment.—This case is important for several reasons: 1. It is an abortive or incomplete form of the Spielmeyer-Vogt group of Tay-Sachs' disease. 2. Epileptic convulsions were the outstanding symptoms. 3. Sommer's sector of Ammon's horn was the chief site of involvement, and as is well known in a great many cases this area is chiefly involved in the so-called idiopathic epilepsy. 4. It shows the value of complete microscopic study in cases that clinically are difficult or even impossible to control by the newer methods of treatment, and it may explain the cause for an occasional failure by dehydration.

Certain Fundamental Cerebral Signs and Symptoms and Their Response to Dehydration. Dr. Temple Fay.

Headache, vomiting, convulsions and stupor are four fundamental symptoms that occur with such regularity in the history of many acute and chronic diseases that they should demand analysis and attention, to determine, if possible, a common factor influencing the nervous system that may be responsible for their production. Although the etiology may vary, the common pathway of the effectors concerned with these symptoms is identical, and implies a common physiologic factor responsive to many generalized remote pathologic disturbances. The rational treatment for these symptoms must be undertaken in terms of correction directed toward the physiologic disturbance; hence with an implied physiologic factor a method of correction designed to meet this need should give fairly uniform responses. The results obtained in an effort to control the physiologic factors involved in the production of headache, vomiting, convulsions and stupor are presented after three and one-half years of experience in the clinical management of these symptoms.

HEADACHE

Headache implies first a generalized pain, deep within the skull, and therefore a pain mechanism capable of being stimulated. Secondly, the presence of this symptom implies also that the end-organs of pain that are stimulated transmit

their impulses to conscious centers within the cerebral mass by definite pathways capable of carrying this type of pathologic sensation.

A study of the terminal pain network and its distribution to the structures of the head and the brain is necessary as the first step in the analysis of the problem. The course of these brain fibers from the surface of the brain, the dura, the skull and the scalp to their points of entry into the central nervous system of the pons, the medulla and the spinal cord, as well as their recognized course from within these structures to the higher levels of the brain and consciousness, must be established. To interrupt the painful stimuli, one must either remove the source of irritation, pathologic or physiologic change, or interrupt either its end-organs, pathways, tracts or cerebral centers.

The use of drugs or sedatives is of temporary value, and offers no solution to the problem when the symptoms are chronic. The surgical interruption of the pathways for pain, as advocated by Spiller in sectioning of the posterior root of the trigeminus, and anterolateral chordotomy are well known to all, and these great contributions have solved the question of suffering in many cases in which the specific pathways for pain are known and can be reached through surgical intervention. True headache, however, has escaped the possibility of surgical intervention because of its diffusion and because the pathways of these pain fibers have not yet been established or recognized. When an organic or focal pathologic condition is not demonstrable, as is the case in many generalized acute and chronic diseases and infections of the body, headache is an accompanying symptom, and it becomes necessary to turn to the definite physiologic factors responsible for this symptom-complex, directing attempts toward rectifying the physiologic disturbance of the distribution of the end-organs for pain, in the peripheral field, if one is to control it.

In dealing with headache, I shall limit the term to pains that lie deep within the head, and disregard the superficial structures such as the scalp, skull, sinuses and muscles, which receive their important supply through the trigeminal, facial and cervical sensory nerves. The problem rotates around the dura and the brain itself, and here the nerve supply anatomically attributed to the dura is ascribed by Spalteholtz to the trigeminus and the vagus. It is questionable from certain physiologic observations whether these fibers for pain actually enter the trigeminal posterior root, although they may pass close to the ganglion. My observations based on over 200 cranial explorations in which the dura was exposed under local anesthesia have established definitely, in my opinion, that electric stimulation, irritation, cutting or manipulation of the dura over almost its entire extent is without conscious pain to the patient, who may be questioned from moment to moment regarding the reactions experienced from these forms of stimulation. Operation on the brain under local anesthesia has necessitated only the control of the scalp and distribution of sensory pain in the periosteal region to obtain a satisfactory anesthesia without experience of pain by the patient. The only portions of the dura found to be capable of painful stimulation are those points where arterial branches distribute themselves over the surface, and these branches are large and grossly recognizable, such as the anterior middle and posterior meningeal arteries. Painful response increases as the arterial trunk is followed toward its origin and as it increases in size near the base. Section of the root of the trigeminus has not, in my experience, destroyed these responses to pain in the dural vessels, and hence I am forced to conclude that the fibers gain entry to the brain through some other route.

With the dura removed, the surface of the brain presents no point for reception of pain to stimulation from cutting, transfixing, electrocauterizing or mechanical irritation. The only painful response that can be elicited in the cerebral area is from the large arterial branches of the middle cerebral artery, the vertebral, the basilar, and certain portions of the posterior cerebral arteries which have been tested. Electric stimulation, clamping or traction of the large arterial branches produces pain referred deep in the eye, vaguely distributed to the temples, as is the case with the middle meningeal and middle cerebral arteries. The vertebral and basilar arteries refer the pain to the back of the head and neck.

Hassin demonstrated myelinated and unmyelinated fibers on the cerebral vascular tree, these fibers following the large arterial trunks during their course within the pia-arachnoid, but terminating when the artery enters the brain substance. Thus, the lenticular striate group of end-arteries are devoid of fibers, whereas the branches coursing throughout the pia-arachnoid, over the hemispheric surface and at the base are plentifully supplied. Cobb demonstrated that the removal of the superior sympathetic ganglion produces a marked numerical loss of capillaries in the hippocampus of the brain of the cat on the side of the sympathectomy. Forbes and Wolff, through a glass window in the skull, recorded photographically the arterial changes secondary to stimulation of the vagus and the sympathetic nerves.

Summary.—There is unquestionably a nerve supply to the large superficial arterial branches supplying the dura and the brain, as shown anatomically and physiologically. The only points of painful irritation determined under local anesthesia are those on the large superficial arterial branches within the dura and the pia-arachnoid. It seems fair therefore to assume that the pain mechanism responsible for headache is situated on the arterial vascular tree, and headache must be interpreted in terms of physiology of vascular change in volume, pressure and position. The many physiologic factors concerned with these changes will be discussed later.

VOMITING

Vomiting, as a central reflex, is a common symptom in many transient or chronic diseases. The center for vomiting is not as yet established, but it is thought that it lies in the medulla and also in the subthalamic region. Two direct observations during exploration of the base of the brain may help to substantiate this view. Irritation of the anterior and lateral walls of the third ventricle in each case has been followed immediately and repeatedly by projectile vomiting when pressure and irritation were produced in this area. The overfilling of the third ventricle is an important mechanism in this respect, and deliberate or pathologic increase of intracranial pressure results promptly in vomiting when this distention is possible after removing the supporting wall of fluid from without. As the equalization and transmission of pressure are entirely dependent on the hydrodynamics of spinal fluid and vascular fluid, it is fair to assume that physiologic changes of pressure result in vomiting and are directly or indirectly concerned with the distribution of fluid volume and its interrelation with vascular and hydrostatic changes. The labyrinthine and peripheral mechanisms responsible for reflex vomiting are not within the scope of this paper.

CONVULSIONS

Convulsive seizures in the light of the present point of view are to be considered as a symptom-complex rather than a disease entity, a view shared by S. A. Kinnier Wilson, Foster Kennedy, Lennox, Cobb, Lind and others. As a symptom-complex, convulsive seizures must be considered as a reflex, mass, motor release of the higher motor centers from controlled inhibitory zones, due to some influence acting on the nerve cells, rather than to involvement of the neural mechanism per se. The symptomatologic, pathologic and physiologic conditions, as well as the experimental production and control of the convulsive seizures, are explainable only on such a basis. The physiologic factor acting on the nervous system in order to release inhibitory zones and thus permit an appropriate stimulus to activate large areas devoted to mass motor movements must be considered.

In my experience, both operative and encephalographic, I have been impressed with the almost complete uniformity with which increase of cerebrospinal fluid in the subarachnoid space over the frontoparietal areas of the brain has been associated with convulsive seizures, whether acute or chronic. The matter of intracranial pressure is not one of degree in this type, but rather one of specific application of that pressure to the important zones of the frontomotor area. In cerebral organic lesions the group commonly complicated by convulsive seizures

has for its pathologic site either direct involvement or secondary disturbance of fluid and pressure relationships in the frontoparietal areas of the hemispheres, cortical and subcortical, whereas there is a striking absence of convulsive seizures in the group in which the pathologic process lies in the occipital lobes or posterior fossa. The hydraulic mechanism is entirely different in these two areas. In the group of the posterior fossa internal hydrocephalus presses the surface of the brain against the dura and the skull, and thus obliterates the cortical fluid spaces. In supratentorial hemispheric lesions, the cortical spaces may or may not be obliterated by the mass, but interruption of the important pathways leads to overaccumulation of fluid behind this point and almost invariably in the frontoparietal areas concerned primarily with motor function.

Summary.—In dealing with the physiology of fluid, one is dealing with the interrelationship between specifically applied pressure and vascular responses from the standpoint of the capillaries. In the last analysis, pressure represents only a disturbance of circulation and the supply of oxygen to the brain. Thus, in accordance with the views expressed by Lennox and Cobb, anoxemia through pressure due to ischemia becomes one of the fundamental factors in the cycle of the convulsion, probably through the lowering of the inhibitory thresholds, permitting a sensory stimulus to involve overwhelmingly the highly integrated motor areas.

STUPOR

Stupor in physiologic terms represents lack of oxygen to functioning cells. Stupor, as one sees it clinically in many diseases, represents a temporary loss of cerebral centers capable of appreciating sensory stimulation from the outside world, or of responding with coordinative integrated motor movements to various sensory stimuli. Stupor ranges from irritability, dulness, torpor and semiconsciousness to complete coma. The physiologic change that occurs, from the standpoint of cerebral function, when a group of persons are confined in a close room with insufficient oxygen probably may be taken as an example of the influence of anoxemia on function. Headache, dulness and irritability develop rapidly. The physiologic change is immediately corrected by proper oxygenation and activity which help to redistribute cerebral circulation. The valuable observations of Landis revealed that during periods of anoxemia fluid passes through the capillaries at four times the normal rate, thus favoring edema of the tissues, and this important consequence must not be overlooked. The striking paradoxical observation of Forbes and Wolff that ischemia deliberately produced by ligation of the carotid arteries was followed by an immediate rapid and formidable rise in intracranial pressure, due to dilatation of the capillaries, with transudation of fluid resulting in edema of the tissues, must command attention. This again in terms of anoxemia or ischemia becomes of great importance in the correlation between cerebral vascular supply and intracranial pressure.

Oxygen is the most important factor that the brain cells are concerned with from moment to moment. The prompt complete loss of function in cases of stroke or complete thrombosis of the middle cerebral artery is well known. The immediate effect of lack of blood and oxygen is partial or complete loss of function of these cells, and unless a compensatory supply of oxygen is readily available through other vascular channels the death of these cells occurs within eight minutes. Winkelman has shown in two important cases the marked chromatolysis that occurs after four minutes of cardiac failure, when resuscitation was possible, and the patient lived as a decerebrated individual for a period of ten days, giving sufficient time to produce the marked changes that were noted following only four minutes of circulatory arrest.

With the brain exposed at an operation, under local anesthesia, with normal intracranial pressure and the surfaces of the brain lying beneath the dura, the addition of a small amount of ether produces such violent changes that one cannot help but speculate on the ischemia produced within the skull, under similar conditions, when the dura or bone has not been disturbed. The brain bulges, the subarachnoid space becomes overfilled with fluid, the venous channels are engorged,

and were it not for the decompressive opening, a marked rise in intracranial pressure would occur. The rise in intracranial pressure itself demands that, with the addition of volume from either the vascular or the spinal fluid compartment, there must be a readjustment of the space-compensating factor. This means that if spinal fluid is added to the cranial content, blood must be extruded to give way before its addition, and if cerebral congestion from the vascular side occurs, spinal fluid must give way before the oncoming increase of volume. When mass lesions occur, both the vascular and the cerebrospinal fluid compartments must be diminished to meet the increased volume, or pressure will be promptly increased, and thus without compensation, diminution of the vascular supply and anoxemia occur. This is the stage of stupor.

The posttraumatic cerebral lesions, generalized infections, tumors of the brain and certain types of cardiorenal failure, in which stupor is a frequent symptom, and the problem of function of the cerebral cells in terms of mental activity must be considered from the standpoint of available oxygen. Increased pressure associated with overaccumulation in either the cerebrospinal fluid or the vascular compartment, or interstitial edema within the cerebral substance itself, exerts its compressive effect on the small capillaries supplying the cortical gray matter and reduces circulation, cutting off available oxygen with consequent loss of physiologic continuity and what may be termed consciousness.

COMMENT

It is evident, therefore, that one is dealing with circulation in terms of oxygen and fluid volume, in terms of metabolism of water which directly or indirectly influence the principal cerebral centers. To correct these symptoms one must deal with the physiology of oxygen and assure its delivery to the brain cells. This means favoring capillary circulation, and if hydraulic pressure or edema of the tissues interferes with this normal circulation, the blood and oxygen must be increased in amount by various physiologic and clinical methods. The metabolism of water, the supply of oxygen and the balancing effect of the equilibrium between acid and base become the important avenues of approach in the control of the symptoms of headache, vomiting, convulsions and stupor. The regulation of these fundamental physiologic factors and the correction of their disturbance require the management of pathologic processes, often at a distance from the cerebral centers. The acid-base balance becomes important in that a shift of the p_H to the acid side favors increased dissociation of oxygen, and thus better utilization by the tissue cells. As Gamble pointed out, acidosis also promotes dehydration, as the fixed base sodium is responsible for the storage of interstitial and blood volume fluid, whereas the fixed base potassium is responsible for intracellular fluid storage. Thus, in acidosis, the fixed base diminishes and dehydration develops. This is a well recognized clinical fact in pediatrics. It also has its physiologic influence from the standpoint of better oxygenation; thus, less capillary permeability ensues and, as a result, edema of the tissues does not tend to occur.

DEHYDRATION

Dehydration must be considered in terms of better oxygenation to the central nervous system, and becomes merely an agent through which one influences physiologic factors. Dehydration must be utilized not as a formula, but with the intelligent application of all of the other factors concerned. For instance, the shortage of oxygen due to anemia is as important a factor as slow pulse rates when the cell count is normal, for as the red cell is the carrier of oxygen, it must be distributed to the tissues in sufficient quantity and rapidity, so that anoxemia will not occur. In cerebral trauma, when the pulse rate reaches 50 or below, even though respiratory and cardiac factors are uninvolved, the volume of blood delivered per minute to the tissues is greatly reduced, and methods of improvement in the cardiac rate have been followed by general symptomatic improvement. The use of large doses of atropine under these conditions, so as to paralyze the vagus bradycardial influence, has been followed by prompt symptomatic improvement of

the headache and lessening of torpor. The diastolic pressure must be carefully analyzed, and constant records maintained so that dissociation of oxygen will be favored in the terminal capillary bed. A diastolic pressure of at least 40 mm. of mercury is required to make possible the delivery of available oxygen to the tissue bed. When the diastolic pressure falls below 40 in the tissue bed, oxygen has left the red cell before it reaches the tissue that it should supply. As anoxemia is followed by a rapid increase in capillary permeability and transudation of fluid into the tissue spaces, a vicious circle develops in that the anoxemia favors edema of the tissues, following which capillary compression by the edema enhances further anoxemia and function of the cell is thus impaired. The control of the edema of the tissues, alone, by hypertonic solutions or dehydration, through the denying of fluid, does not entirely meet the primary deficiency of anoxemia, but greatly favors the further increase in the vicious circle. Those who attempt to obtain results with hypertonic solutions, control of the intake of fluid and purgation, will fail to accomplish the desired result if the basis for the anoxemia is not also considered. For instance, poor oxygenation from obstructing venous stasis, cardiac failure, vasomotor failure or pulmonary impairment cannot be corrected by dehydration alone. Attention must be given to the mechanical factors concerned in the delivery of the red cells and oxygen to the periphery, under proper physiologic conditions. Then control of the tendency toward edema of the tissues and further capillary permeability will find a satisfactory response in dehydration.

Dehydration means the rational balance of fluids so as to restore again a physiologic equation, and naturally applies only to the hydrated group, or to those groups in which hydration of the tissues is present or tends to occur. It is at once evident that the same measures of dehydration would not be carried out with patients who are thin, emaciated and have little tissue fluid as would be undertaken with "water-logged" persons who, as I have noted, are the patients most frequently prone to the symptoms described. The attempt in this method is to reestablish a normal relationship and control of tissue fluids. As throughout medicine, methods of relief, whether medical or surgical, depend on assisting nature in reestablishing the physical laws on which she is dependent. One must not lose sight of the fact that in any medical or surgical procedure of benefit one is at best only assisting nature in her own problem, and one cannot therefore expect a principle or procedure to accomplish alone the end-result. One must vary the procedure within wide limits of intelligent application to meet the many demands in the variety of cases in which it is indicated. One cannot expect the same formula to apply or the same result to be obtained in every case. The fundamental principle, however, when amply modified and amplified to accomplish the desired result after careful study of the physiologic needs involved, brings about a uniformity of response that is striking and of great clinical value. The principle must be utilized with intelligent coordination of all general factors to obtain its best application, and one can expect little primary value from the procedure of dehydration, when indicated, if those who utilize its principle are not conversant with the physiologic conditions and the requirements in each individual case.

The importance of the volume of fluid intake in liquids and food must be correlated with the fluid lost by urinary output and by elimination from the skin, breath and bowels. The exact measuring of this fluid balance can be obtained by simple means within a sufficiently accurate degree of clinical application so that the desired results will be obtained.

If the total amount of liquid consumed per day and the total amount of urinary output is known and the patient is weighed carefully from day to day, the fluid ingested in the diet must take care of the loss by skin, breath and bowel. The variations in weight can be computed in fluid values of storage or additional loss. Thus the attempt should be to establish a desired level recognized as indicated for the condition in which it is employed, with a fixed intake level per day. The diet may be increased or diminished in fluid values until an exact balance of the fluid intake and renal output (which should not vary more than 1 ounce

in each twenty-four hours) is established. When the renal output remains above the fluid intake, after a fixed level has been established, the diet is responsible for this extra fluid provided the patient shows no loss of weight. It is then a simple matter to substitute in the diet foods containing a smaller percentage of fluids: toast instead of bread, dry cereal instead of cooked cereal, baked and French-fried potatoes instead of boiled and mashed, and vegetables comparatively low in water content as compared to those which are high in this factor. A period of complete balance may be initiated so that, with the weight remaining stationary, fluid intake and renal output balance; the fluid content within the diet is just sufficient to take care of the needs of the skin, the breath and the movements of the bowels.

It is evident that climatic changes, secondary toxic and infectious disturbances of renal function, diarrhea and hyperthermia require immediate readjustment of these values. In undertaking a program of controlled fluid balance, one must not lose sight of the fact that fluid entering the body through any avenue becomes a disturbing factor, and unless accurate measurements are made of intake and output no true balance can be obtained. Frequently the physician overlooks as a source of error an enema frequently taken and simply advises the patient to limit the water to "three or four glasses a day." Tea, coffee, milk, soup and beverages often escape attention as fluid factors. Colonic irrigations and enemas are frequent sources of rapid acquisition of fluid. Levels of fluid must be prescribed in exact ounces if results are to be obtained. In other words, the same care regarding a water balance must be instituted as is taken with carbohydrates in the treatment for diabetes or in the ketogenic diet, in which careful measurement of the food values, such as fats, proteins and carbohydrates, is necessary.

During the past three and one-half years, 165 patients with epilepsy have been given a total of 20 ounces of fluid intake per day, without any disturbance of the renal or general physical efficiency. Thirty ounces of fluid per day has been used in the posttraumatic group, in eclampsia, uremia and the cardiovascular types of disease with markedly beneficial results. Forty ounces of fluid per day may be considered the maximum normal requirement for physiologic activity under even the most trying circumstances. Rarely, if ever, have I found the need of prescribing 60 ounces of fluid per day even in the acutely toxic group. It is my opinion, after studying normal persons and various types of disease processes, that the average intake in the normal adult ranges between 36 and 48 ounces of liquid per day. The intake for those persons who indulge in a large consumption of water, because of the theory that fluids are beneficial to the renal function, may range from 60 to 200 ounces per day. There is no physiologic proof at hand as yet to substantiate the theory that large quantities of fluid are beneficial to the kidneys under pathologic conditions, and there is much recent accumulative evidence to show that a rational amount of fluid, even below the normal requirements, has proved to be beneficial to the pathologic urinary conditions, especially albuminuria and tubular casts.

It is significant that, clinically, persons with diseases such as tuberculosis, diabetes and carcinoma, as well as various types of cachexia, are strikingly free (unless there is cerebral metastasis or meningitis) from convulsive seizures throughout the clinical course. Timme and Petty have personally assured me that in their experience they could not recall a true case of diabetes mellitus in which convulsive seizures developed unless these were produced by an hypoglycemic reaction to insulin therapy. Morgan and Devitt have also assured me that in their long clinical experience with tuberculosis, no case of epilepsy developed following the establishment of progressive tuberculosis. Although tuberculosis has developed in many epileptic persons, the reverse has been strikingly absent in their experience. Malignant conditions, unless complicated by direct metastasis, are rarely complicated by this symptom-complex.

It is more than a matter of coincidence that important diseases that constitute such a large portion of our cases should be strikingly free from a symptom-complex that is commonly present under other conditions. The correlation of the

incidence of convulsive seizures in the fat, hydrated, edematous, cardiorenal or glandular dystrophy group becomes a matter for serious consideration regarding the physiology of fluid balance and its indirect relation to convulsive seizures.

It becomes evident, of course, that if one forces fluids on a person who is unable to eliminate them properly because of renal or cardiac insufficiency, one is bound to force other compensatory mechanisms to take care of this excessive factor, or face the inevitable result of edema of the tissues and intracranial pressure. The principle is similar to the one long familiar to the plumber who must supply adequate drainage for containers that receive a constant inflow of fluid. When the drainage or filter mechanism is impaired, the intelligent person usually restricts the source of the supply so that the container will not overflow. This simple simile represents the purpose of dehydration. The modification and the duration of its application are similar. When physiologic filters can readjust or compensate to the proper degrees, then adequate fluid intake may be indulged in without secondary disturbance in tissue function.

Results of Dehydration.—The value of controlling fluid intake and secondarily increasing circulatory activity to the brain has been well established in the group of persons with epilepsy. Other hygienic factors have naturally augmented the results; routine exercise and favorable positions for vascular drainage of the brain, as well as care in diet, with especial regard to the fixed base and carbohydrate components, are interrelated with the problem of the storage of fluids.

Dr. Arnold, professor of obstetrics at Temple University, in his series of cases, found during the past year that the disappearance of the symptoms of headaches, vomiting, stupor and convulsions in the eclamptic group of pregnant women was effected by adequate balance of fluid intake and definite attention to the physiologic principles involved.

Dr. Hersey Thomas, professor of genito-urinary diseases at Temple University Hospital, applied the principle of water balance in cases of prostatic uremia, using a parallel group at the Philadelphia General Hospital consisting of cases in which the intake was uncontrolled and cases in which it was controlled; he obtained markedly beneficial results when limitation of fluid was adequately instituted. His report and series were presented before the Pennsylvania State Medical Society in Johnstown in October, 1930.

Dr. Samuel Goldberg carried the program into the pediatric field and presented the results before the Philadelphia Pediatric Society, showing markedly beneficial reactions not only in stuporous, toxic children, but also in patients with alkalosis, as well as in several patients with idiopathic hydrocephalus, whose conditions have been controlled by this method.

The recent series of traumatic cases presented before the Iowa State Society meeting in 1930, and now reaching a total of 142, has demonstrated adequately that a total mortality of 19.7 per cent has been obtained for the acute traumatic cases and of injury cases to the brain with or without fracture of the skull, and that this mortality is only 9 per cent after the third hour, showing the tremendous decrease in mortality after the physiologic disturbances can be influenced and readjusted. Five years ago, a similar series showed a total mortality of 35 per cent, with 25 per cent as the mortality obtained after the twelfth hour. The only variations in present methods are those I have outlined, which contain the principles of metabolism of water and the adequate management of oxygenation to centers that will survive provided they are given physiologic supplies of the most needed factor, oxygen itself. Eleven cases of chronic migraine and cephalalgia have responded completely to proper hygienic regulation, including the metabolism of water and its balance.

A striking improvement in mentality has been noted in the entire group, especially in the posttraumatic and epileptic groups, where dulness, loss of ambition, inattention and general stupidity have characterized the patient's symptom-complex. Dr. Mathew Moore, of my department, is presenting the results obtained in mental improvement in the epileptic group as a whole, which has been one of the most striking results of dehydration.

Definite control of hypertension has been obtained by regulation of the blood volume through attention to the ingestion of fixed base and of fluids. A fall of from 15 to 25 mm. of mercury is obtained on this basis alone and, when time permits, the method is far superior to the removal of blood volume by venesection in that the fluid volume is removed without disturbing the valuable red and white cells that are destroyed when bleeding is done. The very oxygen carriers and leukocytic defences of the economy are removed by venesection, whereas the fluid volume responsible for a portion of the hypertension can be controlled by limitation of liquid intake and a salt-free (sodium base) diet, without producing a progressive secondary anemia.

The management of intracranial pressure in cerebral lesions and tumors of the brain before and after operation, by this method, has been invaluable. Not only are general symptoms removed, but it makes possible more adequate study of focal symptomatic signs and also delays intracranial pressure, stupor and physiologic dissolution which often develop rapidly in many cases before operation. The intelligent management of fluid makes possible an adequate supply of oxygen to the functioning centers during the period required for careful study, which otherwise would succumb.

My experience with dehydration in the cerebral thrombotic group has been attended with progressive improvement when proper attention to fluid values is promptly undertaken, and the well established zone of edema in the areas of the thrombosis is frequently controlled by hypertonic solutions intravenously.

CONCLUSIONS

The paper gives a survey of the importance, in my opinion, of certain fundamental physiologic factors and their relationship to many symptoms of generalized involvement of the central nervous system, which are applicable to a wide range of the general field of medicine today.

My experience, covering the past seven years, justifies the impression that the fundamental symptoms involved in the problem are dependent on proper distribution of oxygen and water. The proper management of the physiologic relationship between these two factors involves a knowledge of the function of many distant factors, and the satisfactory correction of these symptoms is dependent on intelligent readjustment of the normal physiologic mechanism through measures directed toward water balance and the better utilization of oxygen.

DISCUSSION

DR. N. W. WINKELMAN: Dr. Fay has, as usual, been interesting and full of original ideas. He mentioned the work that I did on anoxemia, but it would take me too far afield to go into this phase of the subject. Cobb's recent paper on the subject is in entire harmony with the work I have been doing. The one phase of the subject I have time to discuss is the rapidity with which water reaches the brain. This was demonstrated a few days ago by a patient at the hospital. She had been examined two days before I saw her by physicians on my own staff and by Dr. Fay, and fluids were ordered increased. At their examination an overriding of the bones of the skull was found and mention of it was made in the record. When I saw the child, two days after fluids had been forced to excess, my examination noted a marked separation of the sutures and bulging of the fontanels. In two days, therefore, the picture had changed from a dehydrated one to one that certainly resembled a moderate external hydrocephalus.

A REVIEW OF SOME PATHOLOGIC PROCESSES AFFECTING THE CENTRAL NERVOUS SYSTEM OF WILD ANIMALS IN CAPTIVITY. DR. WILLIAMS B. CADWALADER.

This paper will be published in full elsewhere.

Book Reviews

LES TUMEURS CÉRÉBRALES. LEURS MANIFESTATIONS—LEUR TRAITEMENT CHIRURGICAL. By T. DE MARTEL and J. GUILLAUME. Price, 70 francs. Pp. 134. Paris: Gaston Doin, 1931.

This report comprises an account of intracranial lesions seen in the Neurosurgical Institute in Paris, from December, 1929, to April, 1930. Realizing the importance of ophthalmologic and otologic, as well as careful neurologic, examination in cases of suspected tumor of the brain, the authors have established a hospital given over to neurosurgery. The consequences of cooperative and intensive study in these cases are obvious. Increased accuracy of diagnosis and a wider operative experience, with a marked improvement in the surgical results, have followed the grouping of such cases in a single hospital. That the careful study of the cellular structure of the verified lesions of the brain and their separation into distinctive pathologic groups have not been neglected is attested by many excellent photomicrographs illustrative of the various types.

Thirty-five cases are described in detail, each with a careful account of the history, presenting symptoms and all other facts on which the diagnosis and localization of the tumor were based. The operative procedures employed are fully outlined.

The first ten cases consisted of a group of lesions of the cerebral hemispheres, eight of which were gliomas and two meningiomas. Both meningiomas were completely removed by electrosurgical methods. Of the eight gliomas, four were astrocytomas. Three of these were more or less completely removed, with excellent results.

In considering this group of cases, de Martel noted that in two instances of tumor of the frontal lobe the diagnosis was made on the basis of early symptoms of mental obtundity accompanied by mild motor involvement. Homonymous hemianopia, and in one case uncinate fits, helped to localize the lesions of the temporal lobe. On two occasions recourse was had to ventriculography, which was confirmed in one case by an operation. In considering de Martel's operative methods, one is impressed by the large size of the bone flaps that he employs. He believes in an operation that practically amounts to a hemicraniotomy, so that he exposes at least three fourths of the lateral surface of the hemisphere suspected of harboring the tumor. From the surgical standpoint, he believes that with proper technic a large flap can be turned down with as little difficulty as a smaller flap. The large flap gives better exposure and more room in which to work, and heals just as rapidly.

The second part of the monograph is devoted to a consideration of lesions in the posterior fossa. Twelve cases are included in this group, with two deaths. Among the lesions are two acoustic tumors, two gliomas of the cerebellopontile angle, two tuberculomas, one astrocytoma and two medulloblastomas. Three cases were diagnosed as arachnitis. The deaths occurred in one case in which there was a large midline cerebellar tumor and in one in which the diagnosis was arachnitis. From the operative standpoint, de Martel believes in turning down a bone flap over the posterior fossa, which is contrary to the practice of all American surgeons. He thinks, however, that he has developed a technic that permits him to throw back a flap rapidly and without danger. He believes that the exposure thus obtained is better than that afforded by craniectomy.

In summing up the neurologic symptoms in this group, he emphasizes that the headache, which is usually occipital, tends to be paroxysmal and runs forward into the frontal region. At the time of the paroxysms of headache, it is not uncommon to have retraction of the neck with attacks of vomiting. He calls attention to other well known signs of cerebellar involvement: vertigo, staggering

gait, interference with balance, unilateral hypertonia in the muscles of the neck with lateral inclination of the head and hypotonia of the muscles and reflexes of the extremities on the side of the lesion. Choked disk develops rapidly in these cases.

The third group consists of six cases of suprasellar tumor. Two deaths occurred, one in a patient with a large suprasellar meningioma, in whom a ventriculogram aided markedly in confirming the position of the neoplasm. Although the patient was operated on in two stages, with complete removal, death occurred from operative shock. The second mortality was the result of a chordoma that involved practically the entire base of the skull. In discussing the diagnostic features of this group of tumors, the primary optic atrophy, bitemporal hemianopia and roentgen evidence of pituitary involvement are stressed. De Martel does not believe that sinus infection ever produces these symptoms. He further believes that roentgen treatment for such tumors should be employed only after operative confirmation of the exact nature of the growth. Unless a microscopic diagnosis has been made, roentgen treatment may result in a loss of valuable time, because only the pituitary adenomas respond well to this type of therapy.

In a fourth group of six miscellaneous cases are found a tumor of the gasserian ganglion, with successful operative removal, an extracranial tumor arising in the sphenoidal sinus, the operative attack on which resulted in death, a case of obstructive hydrocephalus in the posterior fossa from an unknown cause with death following the operation, and a tumor of the pineal body, in which death resulted from surgical intervention.

In his general summary, de Martel states that he believes that cases of suspected tumor of the brain require surgical relief at the earliest possible moment. This is particularly true in cases of suspected cerebellar tumor because of the possibility of a cerebellar crisis and death. He advocates the use of ventriculography if other diagnostic methods fail. He deprecates the use of roentgen treatment prior to operation.

This monograph is an interesting record of one of the first attempts in France to establish a clinic for neurosurgical cases exclusively. It is a great step in advance to take this type of case out of the hands of the general surgeon. Professor de Martel's experiments will be watched with much interest. It is the reviewer's opinion that the results he will obtain by grouping the cases in one clinic devoted to this type of work will be so satisfactory that it will entirely justify his efforts.

DIE DIAGNOSTISCHE BEDEUTUNG DES ROSSOLIMOSCHEN REFLEX BEI ERKRANKUNGEN DES ZENTRALNERVENSYSTEMS. EINE KLINISCHANATOMISCHE STUDIE. By S. GOLDFLAM. Price, 24 marks. Pp. 274. Berlin: S. Karger, 1930.

This is a formidable monograph; it deals with the significance of the Rossolimo reflex and its clinical application, and contains a fairly detailed report of several hundred varied cases in which the test for this reflex was made. After describing several types of reaction, five to be exact, the author discusses the Rossolimo versus the Babinski sign and states that while the latter is a superficial, the former is a deep, joint-muscle-periosteal reflex. He makes the further observations that the two signs do not run parallel, that the Rossolimo reflex is not elicited normally after the first month of life, and that the Babinski sign is more likely to disappear in narcosis or to make its appearance in coma. The statements are made also, although no anatomic proof is offered, that the Rossolimo reflex has its lowest arc in the second and first sacral segments, possibly also the fifth lumbar, that the pathway runs in the lateral column, not within, but next to the pyramidal tract, and that the highest arc is in the cortex of the frontal lobe and central convolution. It therefore is not a sign of involvement of the pyramidal tract.

Based on clinical examination in 288 cases of disseminated sclerosis, the author states that he found the reflex in 81 per cent of cases, whereas the Babinski sign was present only in 54 per cent. He therefore concludes that the Rossolimo sign

is pathognomonic of multiple sclerosis and at once proceeds to make a diagnosis of this disease by means of the sign alone. From the description of the cases one is not convinced that they are all multiple sclerosis; indeed, it is doubtful whether one is justified in calling many of them multiple sclerosis, even though the Rossolimo sign was present. In passing, it may be noted that Goldflam speaks of the sciatic syndrome as being not at all rare in this disease, and that pains, more particularly radicular pains, are fairly common, a statement that most neurologists would hardly accept. He also mentions epilepsy as not uncommon in multiple sclerosis; he links neuromyelitis optica acuta with the syndrome, and asserts that the cortical gray matter is frequently affected, while the pyramidal tract shows no descending degeneration, thus providing the reason for the preponderance of the Rossolimo over the Babinski sign; he definitely relates disseminated encephalomyelitis with multiple sclerosis.

Based on numerous other clinical reports, the conclusion is drawn that the Babinski sign is always (94 per cent) found in compression of the spinal cord, while the Rossolimo sign either is absent or is seen in only 40 per cent of cases. The former is also more common in myelitis and syringomyelia, while the latter is more significant of amyotrophic lateral sclerosis. In tumors of the cortex of the brain, that is, of the frontal and central regions, the Rossolimo sign is present, whereas in tumors of other regions, it is absent and the Babinski sign is present. The Babinski sign was found in 74 per cent of 266 cases of hemiplegia, and the Rossolimo sign in 30 per cent; the latter occurred in lesions affecting the cortex. In hydrocephalus and trauma, wherein the surface of the brain was involved, again the Rossolimo sign predominated. Finally, the sign was found in tetanus and in typhoid fever with cerebral involvement.

In the introduction, Goldflam exclaims, "Back to Hippocrates," meaning that neurologists should return to sound clinical observations. Without quarreling with the intention, it may be said that herein lies both the weakness and the strength of the monograph. Its worth consists of the numerous clinical reports; its defect lies in the overemphasis on clinical signs. It is erroneous to regard a sign as pathognomonic of a disease, and it is a grave diagnostic sin afterward to make a diagnosis of disease on any pathologic syndrome by means of that sign. All one can say, for instance, is that a Babinski sign and absent abdominal reflexes are significant of involvement of the pyramidal tract; however, it is obvious that any one of a dozen pathologic processes can affect that pathway. Goldflam errs fundamentally, therefore, in saying that the Rossolimo reflex is a sign of multiple sclerosis, or, indeed, in attributing so much value to the reflex. None the less, the clinical observations are worth while, even though most of what was said could have been compressed into a monograph of 50 instead of 274 pages.

THE GUIDANCE OF MENTAL GROWTH IN INFANT AND CHILD. By ARNOLD GESELL, PH.D., M.D., SC.D. Price, $2.25. Pp. 317. New York: The Macmillan Company, 1930.

The subject treated in this book is a striking example of the progress of psychiatry in the last three decades. About the year 1900, psychiatry concerned itself chiefly with the classification of the various clinical manifestations present, and the treatment consisted in the proper housing and care of such patients. Then followed Freud's concept of the psychoneuroses. Whatever one may think of his theories, they nevertheless furnished a bombshell in the old concepts not only of the neuroses but of psychiatry. Today Freud's method is an accepted method of treatment for certain types of neuropsychiatric patients and is becoming more and more rationalized so that psychoanalysts themselves realize that not every type of disease can be treated by this method, and that only certain forms are capable of benefit by such treatment.

Following this came the era of focal infections. This also served to uproot the psychiatric point of view, but, unfortunately, millions of teeth and tonsils and miles of intestine have been extracted without benefit; however, this also served its purpose. Then in the last decade came the awakening to the fact that little was known of the psychology of the infant and child.

The National Research Council and certain philanthropic foundations, such as the Commonwealth Fund, became interested, and the latter established experimental clinics on child guidance, which later became permanent clinics, and since then all ideas of child psychology, the relation of children and parents, environment, education and development have come to the forefront in interest. It has, of course, its evils in that many undigested articles and books are being foisted on the medical profession and unsuspecting parents, and there have been too many radio talks by physicians and others, many of whom merely seek publicity; on the other hand, there have been places in which exceptional work has been done in the study of children.

Such an institution is the Yale Psycho-Clinic presided over by Arnold Gesell. He and his assistants have published some excellent results, and this book contains reprints of recent articles with well selected new material, so that one can obtain by perusal of the contents an excellent conception of the old and the modern point of view of the science of the infant and child. The book is divided into three parts. The first part deals with the progress of concepts of guidance. It has an excellent introductory chapter, and then follow the old and the modern points of view. Part 2 deals with the problems and methods of child guidance, and part 3 with the science and protection of the growth of the child.

However, with all the modern trends it must not be forgotten that after all the development of the child depends on the development of the nervous structure. If there is no myelinization of nerve tracts, function is impossible. This is too often lost sight of by those who should know better and is mentioned only to warn those who are willing to believe that the development of the child has nothing to do with structure. This book does not deal with this phase of the subject.

SPEZIELLE CHIRURGIE DER GEHIRNKRANKHEITEN. (Volume 48 of Neue Deutsche Chirurgie.) Volume I. By PROF. FEDOR KRAUSE. Price, 96 marks. Pp. 735. Stuttgart: Ferdinand Enke, 1930.

For some time there have been appearing under the auspices of the *Neue Deutsche Chirurgie*, originally begun by Paul von Bruns, a great many volumes on the surgery of special parts of the body. The forty-eighth volume, which is here reviewed, is the first of three on the special surgery of diseases of the brain and is published under the editorship of Prof. Fedor Krause in collaboration with Dr. K. Boshamer, Prof. Gustav Brühl, Prof. N. Guleke, Dr. E. Harms, Dr. G. Jorns, Prof. Hans Smidt and Prof. C. T. Willich. If this volume of 735 pages is an example of what one is to expect of the two subsequent volumes, which are promised to appear shortly, there will be an exposition of surgery of the nervous system from the German point of view and as such it will be welcome.

The present volume is divided into eleven divisions: (1) Inflammations of the Meninges; (2) Encephalomalacia Based on Closure of the Vessels and Inflammation; (3) Brain Abscess; (4) Brain Discharge and Brain Hernia; (5) Otogenic and Rhinogenic Brain Complications; (6) Non-Otogenic and Non-Rhinogenic Sinus Thrombosis; (7) Pachymeningitis Hemorrhagica Interna; (8) Hemorrhage of the Intracranial Vessels; (9) Congenital and Acquired Venous Tumors in Combination with the Sinuses (Sinus Pericranii): Cerebral Varicose Formation; (10) Apoplectic Regions: Post-Traumatic Delayed Apoplexy; (11) Aneurysm of the Brain Arteries (Exophthalmus Pulsans). For each particular division a special author, presumably familiar with his subject, has been selected.

The first division on the diseases of the meninges by Professor Guleke is treated in the following manner: (1) anatomy, (2) physiology of the normal cerebrospinal fluid, (3) alterations of the meninges and spinal fluid in acute inflammations of the meninges, (4) implication of meningeal inflammation according to the mode of development, (5) clinical symptoms of acute inflammations, (6) diagnosis and differential diagnosis, (7) course of the disease, (8) treatment for purulent meningeal inflammations, (9) tuberculous inflammations and (10) chronic inflammations, the whole taking about 143 pages and followed by an adequate up-to-date summary of the literature, in this instance taking 10 pages.

This is the general scheme of the treatment. The text is not too long and is adequate. The illustrations, especially the color work, are excellent. On the whole this volume gives an excellent indication of the progress of surgery of the nervous system in Germany.

DISCOVERING OURSELVES. A VIEW OF THE HUMAN MIND AND HOW IT WORKS. By EDWARD A. STRECKER, A.M., M.D., and KENNETH E. APPEL, PH.D., M.D. Price, $3. Pp. 306. New York: The Macmillan Company, 1931.

In the beginning of chapter 5 of this book there is the following statement: "This book is meant to be entirely practical. It is not written for psychologists or psychiatrists." It is obviously for the layman. A review in a scientific journal is perhaps out of place. In recent years many semiscientific medical books have been written for the public. In the foreword, the authors comment on the fact that the public has intelligently grasped the aim and scope of physical hygiene, and that "the stakes in the game of mental hygiene are even higher."

Is there a need for such a book? This is a difficult question to answer. The authors believe that there is. That such books have widespread popularity, there is no question. Recently, the "book of the month" was "The Human Mind." It had a wide sale. Since then the author has become the editor of a page (classified under the caption "The Modern Homemaker") on mental hygiene in the *Ladies Home Journal*. In this department he answers questions sent to him by readers. His photograph is prominently displayed. This is not meant as a criticism, but is a statement of fact indicating a tendency of the times. It may be that the subject of mental health will become as popular as dietetics.

The problem of mental hygiene has undergone an interesting development in the last three decades. It started with Freud. With the popularization of psychoanalysis, discussions of sex became the fashion; then followed birth control. Child guidance clinics were developed in various parts of the country. With the advent of the radio, lectures on mental health became common. The movies and talkies helped. Now the general public is becoming complex conscious. With this, of course, came a number of popular books on the subject. The public has probably gained from all this. It certainly knows more about mental health. There is no question that some evils have arisen. What the future will be is rather difficult to tell in the present development of the situation.

If one considers this book, will healthy persons understand repression, dissociation, anxiety states, symbolism, substitution, projection, identification and idealization, sublimation and so on; will they get out of it what the authors intend, and, if so, will it do them any good?

In regard to the patients, who will undoubtedly buy this book more than any other class, will they be able by reading it to understand better their own problems? Can one imagine a psychasthenic person receiving help from this or from any similar work? On the other hand, aside from the question of the need for such a book, the authors have written a readable and interesting book and have presented their subject well.

THE ADRENALS. By MAX A. GOLDZIEHER. Price, $7.50. Pp. 436. New York: The Macmillan Company, 1929.

The literature on the internal glandular system is growing beyond all bounds—interesting and fascinating—and while it is still somewhat in the class of mystery stories, more and more are the biochemical facts being unfolded on which this enormously important interrelated series of structures operates. This book by Goldzieher, of which 100 pages are bibliography, is a biography of an important unit of the endocrine states. The early life of the suprarenals, their development through the ages and their anatomy, physiology and pathology, together with the importance of their activity in various disease states of man, are all to be found in this volume. Much available literature has been utilized to give the reader the most important outstanding values in the almost finished picture of the suprarenals. The bibliography is rather complete and alone is well worth while. While

the discussion on various symptom-complexes is interesting and instructive, in the light of the investigations of the past year or two on the physiology of the suprarenal cortex by Swingle, of Princeton, and Hartmann, of Buffalo, the pages devoted to Addison's disease, which the author attributes largely to an insufficiency of the output of epinephrine, must be read in the light of historical retrospect, for Swingle and Hartmann independently have practically not only shown that morbus Addisonii is a disease of the suprarenal cortex, but have produced an active principle derived from the cortex, which seemingly is as specific in this devastating disease as is insulin in diabetes. However, a year ago, when Goldzieher published this book, the work on the suprarenal glands had not as yet progressed to the point at which publication was advisable. If there were any real criticism it might be said that the bibliography is by and large of European character. Some American writers are mentioned, of course, such as Cannon, Hoskins and Stewart and Rogoff, but they are conspicuous by their rarity. This is accounted for by the fact that Goldzieher was for some years professor of pathology at the University of Budapest.

The book is well printed; the few illustrations are limited to pathologico-anatomic specimens, all of which are good, and the volume as a whole is well worth possessing, not only by the student interested in the internal glandular field, but by physicians generally, especially those whose work is largely with the vegetative nervous system.

THE MATRIX OF THE MIND. By FREDERICK WOOD JONES and STANLEY D. PORTEUS. Price, $3. Pp. 457. Honolulu: University Press Association, University of Hawaii, 1928.

This book was made possible by a grant from the Rockefeller Foundation to further research in the biologic sciences at the University of Hawaii; it is intended to provide a common background on which to project further studies of human material in the investigation of racial differences. The authors state that other books do not correlate structure and function, and that it is the purpose of this one to make good the deficiencies of the anatomies that disregard function and of the psychologies that neglect structure. Dr. Jones, an anthropologist and former anatomist, discusses the nervous system in the first forty-three chapters, and Dr. Porteus, a clinical psychologist, devotes the last fifteen to a consideration of behavior.

The effort is certainly worth while, but it is to be feared that the authors have not been successful. They attempted too much and did not accomplish half enough. Herrick, for instance, has done infinitely better in his "Introduction to Neurology"; the reason why one cannot match psychologic work with that classic is because psychologists still refuse to admit ignorance and perforce use speculation, inference and analogy to bridge gaps in knowledge.

It is difficult to say for whom the work is intended. It is much too elementary and certainly too brief to cover the field. The facts are generally correct, although in one place (p. 144) the spinothalamic tract is confused with the median lemniscus and is made to cross in the medulla; in another, some curious remarks are made about phantom limbs, and in still another there is some dubious symptomatology of the thalamic syndrome. On page 162, the statement is made in all seriousness that the reason youth is chastized on the buttocks is because the ischial region is informative by virtue of special sensory areas that subserve learning. The style too, particularly of the first part, is rather journalistic and too enthusiastic for sober, scientific discussion. There is entirely too frequent use of the words marvelous and wonderful. All in all, while the book is not bad, it is just another book.

BEITRÄGE ZUR HISTOLOGIE, PATHOGENESE UND EINTEILUNG DER ARTERIOSCLEROTISCHEN HIRNERKRANKUNG. By VON KARL NEUBÜRGER. Price, 8 marks. Pp. 118, with 33 illustrations. Jena: Gustav Fischer, 1930.

This monograph takes up in an orderly manner the changes in the blood vessels and in the tissues of the brain resulting from the wear and tear of age, known

under the collective term of arteriosclerosis. There is nothing startlingly new in the book, but it is rather a collection of typical cases of various sorts to illustrate the varied types of change that may occur in the large and small blood vessels. The book is divided into two main divisions: In the first portion of the monograph, the changes in the blood vessels themselves are considered under the following heads: atherosclerosis, arteriosclerosis, capillary fibrosis, endarteritis of the small vessels and calcification. The second part of the book deals with the changes that result in the brain from the disease of the vessels. This is divided into: anemic necrosis, red infarct, incomplete necrosis, small "Verödung," encephalitis subcorticalis chronica, état vermoulu, diffuse parenchymatous "reduction" and état criblé.

Neubürger attempts to make a general division of his cases into what he calls the senile and the hypertonic stages; he explains the latter as those in which hypertension was present, especially in the presenium, and the former as the older patients without a marked increase of blood pressure. While it may be possible to draw such fine distinctions in many cases, it is not in all cases, for obvious reasons. The reviewer does not believe that the book adds materially to the knowledge, but that it is a good collection of cases to illustrate the various forms of changes in the blood vessels of the brain and for this reason is worth while. The previous works of Spielmeyer, under whom Neubürger studied, and Jakob have been used as a basis for the book.

PARENTS AND THE PRE-SCHOOL CHILD. By WILLIAM E. BLATZ, M.B., PH.D., and HELEN BOTT, M.A. Price, $3. Pp. 340. New York: Wm. Morrow & Company, 1929.

In this book a professor of psychology and an educator have combined forces to furnish parents with such knowledge as is needed to train normal children so as to avoid the many pitfalls that lie in the way of every child in the course of his social adjustments. While the authors are interested in the general principles and theories of the development of the child, their aim in this book is to acquaint parents with ways and means of meeting the difficulties that arise in the training of the preschool child.

They do so by presenting clinical studies of normal children in such simple terms and by dealing with typical problems of behavior in a way that makes it relatively easy to understand the psychologic principles that determine behavior and comparatively simple to apply these to other cases. The problems are treated from the standpoint of the parent and are considered from a practical point of view. Fundamental elements in the training of the child, such as the formation of habits of eating, sleeping, playing and the like, are amply illustrated and discussed. Good methods of dealing with the fears of children, temper tantrums and sex training are shown in describing what has been done in particular cases with successful results. Thus a technic is indicated for dealing with behavior disorders in incipient form early in the child's life.

Part III presents useful forms of collecting facts about children. They include consultation forms that are used at St. George's School for Child Study, Toronto, as well as home records for parents that have proved satisfactory.

By keeping in mind the specific needs of parents for guidance, the authors have succeeded in writing a valuable compendium of information for parents of normal children.

THE EVOLUTION OF THE NERVOUS SYSTEM IN INVERTEBRATES, VERTEBRATES AND MAN. By C. U. ARIËNS KAPPERS, M.D., Amsterdam, D.Sc., Yale University. Pp. 335. Haarlem, Holland: de Erven F. Bohn, 1929.

In a volume of more than 300 pages the author gives the chief evolutionary principles and most characteristic forms of the evolution of the nervous system in

invertebrates, vertebrates and man. There is first an introduction in which the general principles of neurobiotaxis, an original conception, are emphasized. This is followed by an exposition of the nervous system of invertebrates and of vertebrates. Chapters are devoted to the further development of the forebrain and the evolution of the brain stem. There is an especially interesting chapter on the metabolic tissue of the central nervous system, including the choroid plexus, ependyma, neuroglia and the phylogenetic development of the meninges. One of the most interesting parts of the book is on the anthropology of the brain, in which the relation exponent, cephalization coefficient, in various human races and the influence of cephalization coefficient and body size on brain form are given adequate exposition. This is followed by the description of prehistoric brains, including the pithecanthropus brain, the Piltdown cast, the brain of the Neanderthal men, the brain of upper paleolithic men and a discussion of the brain of a recent paleolithic race, the Negroid races, the brains of the Eskimo and North American Indian and Asiatic brains. There is an addendum which is purposely limited so as not to complicate the work. The book is profusely illustrated, there being 146 figures, most of them original.

It would be impossible to review this book adequately. Suffice it to say that it is fully up to the standard of this excellent Dutch scientist and should be in the hands of all neurologists. Clinicians are too prone to neglect and to overlook the surprising amount of valuable information to be obtained from comparative neurology.

LA SCIATIQUE CLINIQUE-THÉRAPEUTIQUE. By J. A. CHAVANY. Price, 18 francs. Pp. 53. Paris: Gaston Doin, 1931.

According to the author, there are three types of disturbances characterized by pain in the sciatic distribution: true sciatica, symptomatic sciatica and pseudosciatica. The first, which would seem to be an acute infectious disease of the order of rheumatism, is characterized by severe pain, first in the back and later in the limb, which is almost always unilateral and tends to recover spontaneously after a few weeks. The subjective and objective disturbances in this condition are treated thoroughly, and various deviations from the ordinary type are described. Symptomatic sciaticas due to syphilitic radiculitis and spondylitis and to various proliferative and neoplastic processes, as well as those due to bony changes about the pelvis and spine, are also discussed. Among the metabolic disorders, diabetes and gout are emphasized as etiologic factors, and the various infections, particularly gonorrhea and zona, are mentioned. The pseudosciaticas are due to cellulitis, myositis and vascular changes, as well as to chronic arthritis of the hip.

The treatment is considered more or less in the manner of textbooks, emphasis being laid on epidural injections and radiotherapy. Surgical intervention is discussed in a short paragraph.

THE PSYCHOLOGY OF THE COMMON BRANCHES. By W. H. PYLE. Price, $2.10. Pp. 381. Baltimore: Warwick & York, Inc., 1930.

Professor Pyle presents his interpretations of the psychologic studies that have been made on the teaching of reading, spelling, handwriting and arithmetic and on the diagnostic and remedial work in these branches. His book is an elementary textbook that necessarily deals, as the author explains in the preface, with established principles and the most probable interpretations. There is little discussion of the many disputed problems in the teaching of the common branches or in the field of learning. The book is a good practical manual, however, for the reader who will bear in mind that future experimentation and interpretation will probably change the significance of many of the principles presented. It has a further value for the advanced as well as for the elementary student in that each chapter is followed by an up-to-date bibliography with useful abstracts of the important material on teaching, testing and remedial work in the common branches.